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The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

and

The Foundry Trades' Equipment and Supplies Association

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Hardness

Engineers seem to possess a mentality which urges them to correlate diverse types of tests to those with which they are most familiar. Thus, in most engineering handbooks, there appear tables, graphs and a simple formula for converting Brinell hardness numbers into tensile strengths expressed as tons per sq. in. Efforts are also made to establish relationships between Brinell hardness and machinability. Yet we doubt if more than a small minority understand the true complexity of hardness. Dr. H. O'Neill has written a fairly lengthy and erudite text-book on the subject. There are the philosophical, physical and mechanical aspects of hardness which are as difficult of correlation as are the various types of static and dynamic tests. The cutting hardness is considered to be quite different from the Brinell number, as anybody who has tried to machine manganese steel well knows, whilst Mohr's scratch hardness bears but little relationship to indentation hardness. Naturally, a number of tests do fall into the same category, and as such are really worth while correlating, if only on account of the commercial difficulties which arise from time to time. These are due to manufacturers and buyers expecting a fixed relationship to exist between the various forms of test results. A serious contribution to the mitigation of these difficulties has been made by Mr. J. S. Vanick and Mr. J. T. Eash in a Paper which they presented to the last meeting of the American Society for Testing Materials. For their experiments they used very hard test blocks of chilled cast iron and equally hard steels. A matter of first-class importance to the British roll-founding industry is that the figures obtained by the scleroscope of German design are distinctly higher than those given by other makes of instrument. A personal impression received many years ago is that the mass of the test-piece reacts upon the accuracy of the figures given by the scleroscope.

Of great interest also is a test result which showed that, on chilled alloy cast irons, the Brinell values are 40 units harder than those obtained from steels of correspondingly the same scleroscope hardness. The authors evince a preference for the use of the Brinell instrument for evaluating the hardness properties of modern chilled iron rolls, using a tungsten-carbide ball, because the structure of the roll is slightly heterogeneous and this method embraces within its testing area a much larger surface, and so can yield a better average figure. The publication of these results comes at a particularly appropriate moment, as the British Standards Institution has at the moment under consideration the publication of material germane to the correlation of the various values given by the different hardness testing machines. Especially must the Committee charged with this work take cognisance of the results obtained from the hardest ranges of engineering materials, for it is here where the maximum of irregularities occur. British foundry owners will certainly endorse the suggestion made by the authors of the Paper referred to that the acknowledged differences in values given by the German and American scleroscope machines should be adjusted by reference to the International Association for Testing Materials, as it is quite certain that German chilled roll founders have no desire to claim for their product a hardness which is fictitious when measured by yardsticks other than their own.

A Non-Existent Problem

We have always maintained that, as a national problem, labour turnover does not exist, and as matter for study is not worth serious large-scale investigation. We have previously pointed out that this interest in labour turnover arose in America, where conditions are entirely different from those obtaining in the United Kingdom. Our view is that too low a labour turnover indicates a *laisser-faire* attitude by both employer and employee. Our belief is well confirmed by a survey made by the National Institute of Industrial Psychology in the London area. Here, in the great Metropolis, where there is a large percentage of foreigners engaged in certain trades, this position is well shown. The statistics which really matter are those concerning the men—the main-stay of British family life. The statistics show that in large factories the labour turnover is but 16 per cent.—a figure we deem to be a healthy one. For large financial concerns it is down to 4 per cent.—a condition which indicates a general lack of enterprise. When one turns to the catering trade of London, which is largely in the hands of foreigners, and which demands attendance at work whilst most of the population is playing, the figure rises to 57 per cent. This is obviously very high, and the conditions in certain aspects are parallel to those of the United States. The average figure for the labour turnover amongst men in the London area is 15 per cent., and is, we would imagine, about 5 per cent. higher than the rest of the country. Labour turnover is supposed to cost industry a mint of money, but on the credit side is the polish obtained by the " rolling stone " which eventually comes to rest somewhere to gather " moss " for himself, bestowing the benefit of his experience on his fortunate employer.

Progress of Middlesbrough Foundry Courses

By C. R. GROVES, M.Sc., A.I.C.

The need for technically-trained men in the foundry industry is widely recognised. There are several institutions in this country which provide systematic full-time courses in foundry technology for various types of student. On the whole, the courses provided by each institution are intended to attract a particular type of recruit, and the work of the various schools does not seriously overlap.

In July, 1932, an article was published in the JOURNAL dealing with the then-recently established course at the Constantine Technical College, Middlesbrough. This course has existed long enough now for an estimate of its value to be made. It is planned as a two-year course adapted to youths of 16 upwards, who have received a good general education, and is mainly intended to follow directly on the secondary or junior technical school curriculum.

The course is essentially a practical one, and the Constantine College is admirably equipped for the purpose. Much of the instruction is given by a full-time foundry instructor with many years of industrial experience in pattern-making, and in many branches of foundry work. The first year is devoted largely to the necessary preliminary subjects, such as elementary mathematics, physics, chemistry and metallurgy, although contact with the experimental foundry is made at once, and a certain amount of time is spent in drawing and pattern-making. In the second year, the instruction given includes foundry technology, pattern-making, drawing, physical metallurgy and metallurgical analysis, materials testing, and general engineering, and factory organisation. The whole course, including the practical work, is correlated so as to teach and illustrate the fundamentals of modern foundry practice.

The equipment includes a complete experimental foundry with cupola, gas-fired crucible melting furnace, high-frequency electric melting furnace, moulding pit, core bench and core stove, sand mill, oil-sand mixer, and all the usual accessories. There is also a physical metallurgy block with heat-treatment furnaces, testing machinery, photo-micrographic outfits; spacious laboratory for metallurgical analysis and well-equipped workshop and materials testing laboratory.

The students sit for the examinations of the City and Guilds of London Institute in Foundry Practice and Science and in Pattern-making, and many successes in these examinations have been obtained, including the Bronze Medal and Silver Medal for Pattern-making.

No difficulty has been experienced by students in obtaining employment at the completion of the course, and although the course has only been in existence a few years, and practically all the ex-students are still under the age of 30, the following responsible positions are held by ex-students in various parts of the country: technologist in a large modern foundry making small general castings chiefly in special irons; assistant foundry manager in a foundry on small castings for electrical work; assistant to firm of consulting metallurgists, visiting foundries as technical advisor; manager at firm supplying foundry requisites; manager of engineering works; draughtsman in foundry making general steel castings; assistant to manager of steel-works, etc.

Correspondence

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

A Tropenas Blowing Record?

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—The accompanying chart [a portion of which is reproduced below] shows a day's work with a 2-ton Tropenas converter plant. The twenty-two heats shown were taken continuously from one converter. We commenced blowing the first heat shortly before 12 o'clock. and finished the last heat about twenty minutes to six. We think this must constitute a record for speed of working in this country. The regularity of heats is also remarkable. It will be understood that the chart indicates air pressure and time.—Yours, etc.,

HARRY A. BAIRD

(Director, Archibald Baird & Son, Limited).

Hamilton.

July 7, 1938.

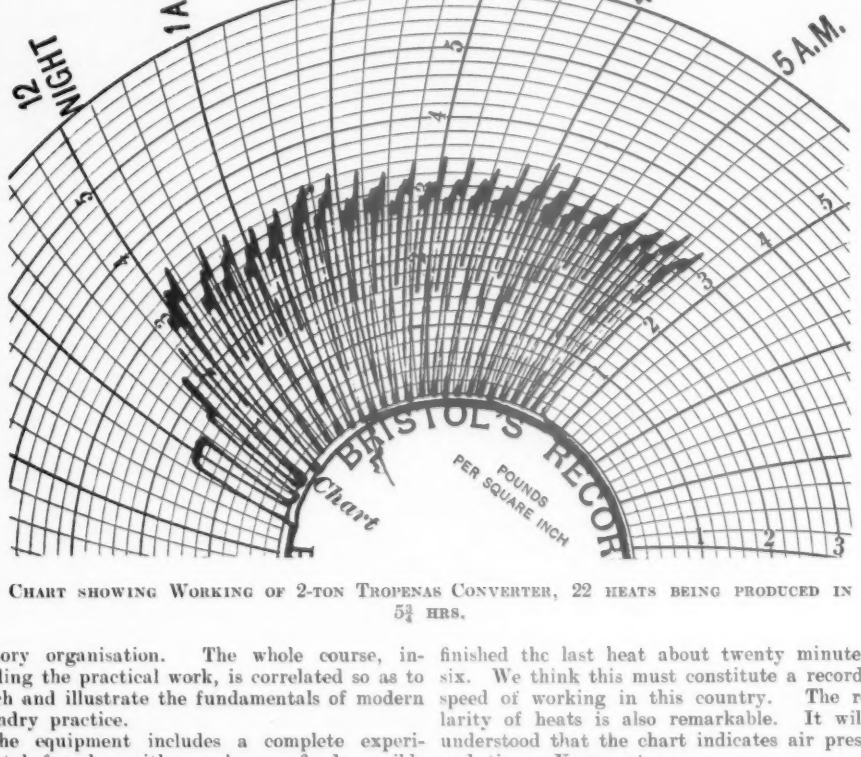

CHART SHOWING WORKING OF 2-TON TROPENAS CONVERTER, 22 HEATS BEING PRODUCED IN 5¾ HRS.

Random Shots

Cricket, it seems, is doomed to a season of disappointment. The expectant thousands at Manchester who looked forward to a brilliant Test match have had their spirits damped (surely it didn't rain there?), and now comes the latest blow to cricket—the postponement of the annual match between the Institute of British Foundrymen and the Works Managers' Association. Behind this postponement lies the sad story of lack of support, unhappily in the camp of the foundrymen rather than of the works managers. "Marksman" wouldn't like it to be thought that the foundrymen are settling down into a comfortable middle age, when they prefer the pursuit of the more sedate golf-ball round the pleasantly undulating course at Matlock. Are there no young men whose secret ambition is to emulate a Bradman, or less grandiose, whose fingers itch once again as they watch, maybe, an immaculate game on some equally immaculate country green? Surely, anybody who can rally to impromptu cabaret (of immortal memory) should not be afraid of cutting an unconventional figure on the cricket field? So take a leaf out of C. B. Fry's book—he says, "I would like to see somebody do something a bit unconventional and hang the consequences"—and write at once to Mr. J. E. Hurst at Lichfield offering your services.

* * *

Il faut voyager pour apprendre is an old saying, and a very true one. On a recent visit to the Continent, "Marksman" learnt of many things of interest, ranging from a machine for scraping new potatoes outside the greengrocer's shop (which, almost incredibly, really worked) to the way in which *on mange en Angleterre!*

* * *

It is certainly a nice gesture on the part of the French just now to go out of their way to understand the customs of their eccentric neighbours, the English (a desire which obviously arises from the pending Royal visit to Paris), but they are doing it so thoroughly that one newspaper writer has managed to teach the English something more than they knew themselves. This is what they eat (he says) in England:—For breakfast (in a modest home, mark you) one begins with ham and eggs, follows with kippers, then a liberal plate of sausage and kidney, and finally finishes with porridge (that is, a soup made of milk and oats). At noon the lunch is light. (How's that for the old steak and kidney pudden?) After the sacred rite of the "five o'clock" one partakes of dinner, for which, of course, one takes roast beef, rightly allowed by this expert to be *sans rival*, or perhaps lamb and mint sauce. So far, so good, but would you believe it? In spite of the fact that it is typically Irish, these extraordinary English still pay homage to Irish Stew!

* * *

Here follow a few recipes, typically English, which it is suggested that the French housewife might try out on her family during the period of the Royal visit. Why not make a Welsh Rabbit, not forgetting on any account the *soupçon* of white wine in it? Why not tempt the palate with leg of lamb *a l'anglais*, boiled slowly with onions, carrots and even garlic?

* * *

By the way, in the aluminium research laboratory at Chambery, over which M. Gauthier, author of this year's French Exchange Paper, presides with distinction, even the ladders are made of aluminium. They only need to be made telescopic, too, to provide the perfect equipment for the top flat burglars.

MR. J. LAUCHLAN, secretary of Craven Bros. (Manchester), Limited, machine-tool makers, Mr. H. Moliver, works manager, and Mr. J. H. Rivers, chief designer, have been appointed directors of the company.

The Parkinson Stove Company's Mechanised Foundry

The Stechford factory of the Parkinson Stove Company, Limited, was established in 1913, although the company is much older, and dates back to 1899. Like many companies which grew up over a period of years, its construction—which at the time might have been considered in line with the current practice of those days—was found inadequate for present-day requirements.

For some considerable time past, the management of the Parkinson Stove Company had been devoting their energies to bringing their factory completely up-to-date, and it can be said that the plant to-day represents in all its sections possibly one of the most modern and highly-organised plants for the manufacture of gas appliances.

The works covers 18 acres of land, and the writer was recently afforded the opportunity of visiting them. While it would no doubt be interesting to review a number of the sections, such as the press shop, enamelling department, conveyor assembly shop, etc., the department in which readers of this JOURNAL will be most interested is the foundry.

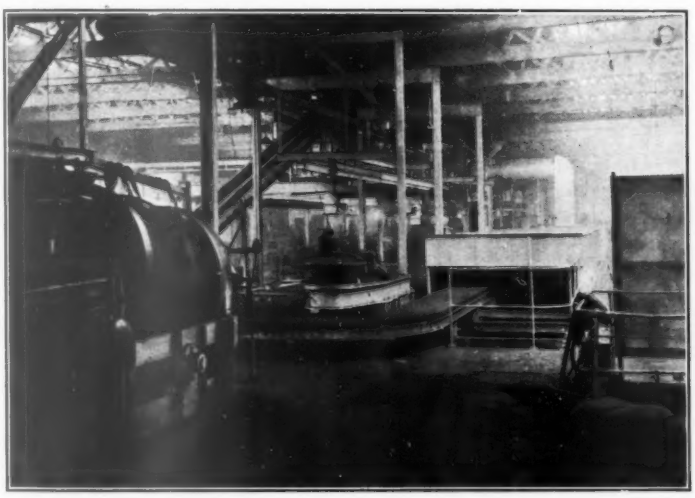

FIG. 2.—SAND MILL, MOULD CONVEYOR AND COOLING TUNNEL.

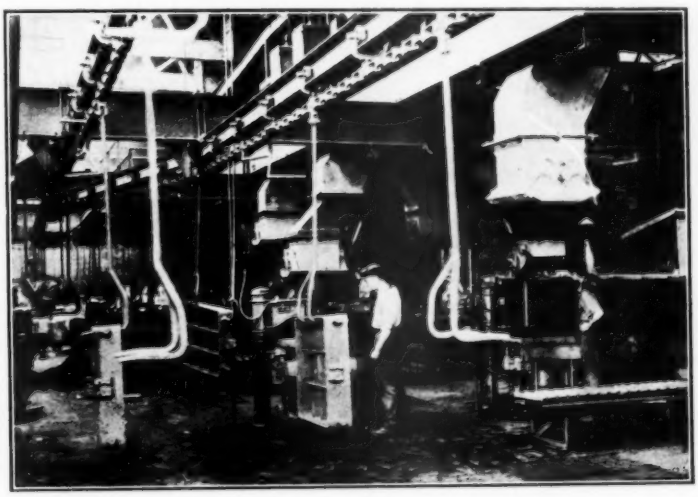

FIG. 3.—VIEW OF MOULDING STATIONS, SHOWING THE B.I.C. MOULDING MACHINES, ROLLER PATHWAY AND (IN FOREGROUND) PART OF KNOCK-OUT GRID.

The site of the foundry is alongside the main Euston to Birmingham railway line, and the facilities for handling coke, scrap, pig-iron, etc., are in line with modern practice. The bulk of incoming materials arrive over the private sidings, and are unloaded into wooden storage bins. (It has been found in practice that, due to many reasons, wooden bins are superior to concrete.) The raw materials are taken up to the cupola charging platform by an electric lift, and all charges are weighed, carefully checked, and an accurate record is kept of them.

The foundry proper covers an area of approximately two acres, and, due to the constantly increasing production that the company have experienced over some considerable time, in spite of the fact that night shifts were being worked, the area was found inadequate to meet the demand. As there was no further room for expansion economically, the question of mechanisation was investigated, and it was finally decided to lay down a completely-mechanised repetition plant for the production of light castings. This work was commenced in January, 1937, and the plant put into operation in September of that year.

Reverting to the hot metal side, one commendable feature is that, during patching, the men working are protected from danger by a safety plate, which is placed inside the cupola at the landing stage level, just below the charging hole, consisting of a centrally-hinged circular plate, resting on an iron bar stretching between the sill of the door and a notch in the back wall. In the interest of safety, this is a measure which might well be standardised throughout the industry.

The introduction of the mechanised unit necessitated a complete revision of the previous pouring practice, and it was found necessary to line down the cupolas to give an output of 4 tons per hour. There are two cupolas, the original diameter being 54 in., and these have now been lined down to 3 ft. 6 in. The construction follows standard practice, there being two rows of tuyeres, four in each row, of the usual splayed variety. The coke consumption is of the order of 10 per cent., and 400 lbs. of limestone per ton are used, as with the type of casting manufactured it is found necessary to maintain a very fluid slag; this naturally also assists in maintaining good operating conditions when the cupola is running over long periods. At such periods the mechanised plant is running on two shifts, and the cupolas are in blast for 16 hours continuously, and are changed over daily.

The cupolas are tapped into bull ladles of 5-cwt. capacity, and a monorail connects the cupolas to the pouring station on the conveyor plant, which is just adjacent. It is interesting to note that there is a special section for lining and drying the 100-lb. shanks used by the pourers on the conveyor, and that the design of the hand shanks is such as to make them as light in weight as possible, consistent with safety. Another point which may be of interest is that, although a light monorail system is provided over the conveyor to assist the pourers, in general they prefer not to use this.

From Fig. 1 the general lay-out of the plant can easily be envisaged. The following are major points of interest:—

The Knock-out

The cast-up moulds are passed into the cooling and fume-extraction tunnel, come to the knock-out position, where they are mechanically pushed off the conveyor by two pneumatically-operated pushers. There are two knock-out stations, and two men at each station. As the output of the plant is considerable, it was found that the pneumatic pushers effected a great saving in time, and enabled the work to be performed most efficiently. The moulds are pushed on to rails over the knock-out grid, and the knock-out men break the boxes, throw the castings into containers and hang the boxes on one of the return-box conveyors. These consist of two separate pendulum conveyors, the one returning the larger boxes to the first two machine stations, the boxes being of the approximate size of 36 in. and 24 in., while the second conveyor services the boxes to the smaller machines. This system is found under the conditions prevailing to be considerably more efficient than using return gravity or power-driven flat conveyor, as it keeps the boxes in constant circulation, and it is not necessary to sort them out to ensure that there is always available at or near its respective machine a box of the correct size.

The sand, running through the knock-out grid, falls on a second grid, which is 9 ft. by 5 ft. This grid was installed subsequent to the operation of the plant, and was designed and manufactured by the Parkinson engineering staff; it is of the shaking variety, and was installed for the specific purpose of preventing thin pieces of flash from getting on the belt, as it was found that the electro magnet did not in some instances eliminate these. The small pieces of flash, etc., caught on this grid are removed weekly and returned to the cupola stage. A hood is provided over the knock-out to extract dust and steam, and although satisfactory up to a point is having further consideration by the management, and may shortly be replaced by a downtake system situated between the two knock-out grids.

The sand is fed from beneath the knock-out by means of a rotary turntable, and then passes to a cross belt, which also carries away the spilt sand from the machine and also any surplus sand from the main band delivery system.

It will be noticed from an examination of Fig. 1 that this cross belt has always a layer of cold sand on it prior to the hot sand from the knock-out reaching it. This sensible arrangement ensures a long belt life. The cross belt feeds in turn under the main sand belt, which runs at 100 ft. per minute, is 4 ft. wide, 88 ft. between centres, and is housed in a well-lit trench. At the far end of this belt there is a grid for taking in old sand from the general floor, and the sand next passes beneath a 30 in. overband "Rapid" magnetic separator. At

the extreme end of the belt is a 5-ton hopper with patent plough feed, so that any additions to the sand in the system can be made.

The main return-sand belt discharges into the boot of a bucket elevator, which is of a rather unusual type; the buckets are 2 ft. long and 2 ft. wide, and are suspended between two link chains. The circuit taken is in the form of a square, and it should be noted that the return-sand belt and bucket elevator are common to the two systems. There are approximately 80 tons of sand in the system. The bucket elevator operates at 40 ft. per minute, and handles up to 50 tons of sand per hour. It discharges its load by tipping into a rotary sieve of § in. mesh, 11 ft. long by 4 ft. diameter, there being one sieve for each main sand hopper. In this screen it has been deemed worth while to introduce a cooling blast of air. Over-matter falls down a shute to fill a barrow at ground level. The screened sand falls into a 40-ton storage hopper; the feed from this hopper is of the rotating plate type with plough, fed directly into a Morris continuous mill of the Bartlett Snow type.

The mill, which is of standard pattern, is 4 ft. in diameter and 6 ft. long, and of the barrel type. Its speed and angle of tilt are variable, and the output can be regulated up to between 25 and 35 tons of sand per hour. Water additions are made continuously at points where the sand is discharged into the mill, as it will be realised that this mill is of the continuous type. The water is controlled through a recording meter, and maintained at approximately 6 per cent. The sand discharging from the mill is fed by a short cross belt into a disintegrator of the revolving rod type, the rods being of nickel-chrome steel.

The disintegrator discharges, in turn, on to a belt 2 ft. wide running at 100 ft. per min., carrying the sand up the necessary inclination to feed the main sand distribution conveyor above the moulding-machine hoppers. This main sand feed conveyor is of the push-plate type, and its most important advantage obviously is that it obviates the necessity for any attention to maintaining the moulding-machine hoppers full. The plates are 22 in. wide and spaced at 2-ft. intervals. The filling of the hoppers is achieved by the complete or partial opening of shutters. The feed is automatic inasmuch as all hoppers are normally kept full, and although the shutters may be opened when the hopper is full, naturally the sand is carried on to the next one, and so on. As there is a surplus of sand, the hoppers are constantly full and a small amount of sand is discharged at the far end of the push-plate conveyor, to feed, as mentioned before, on to the knock-out cross belt. There is also a take-off at right angles from this main sand belt to provide a certain amount of sand for the general foundry. The belt is 18 in. in width and feeds a storage hopper which is used by the floor moulders.

It is interesting to note that facing sand is not used, and at the commencement of operation of the plant, a lot of the old-time moulders felt that this was impracticable, and that the sand could not be as good as when prepared by old-fashioned methods. They have so completely changed their outlook that they are actually using the sand from the cross belt as facing sand on the floor and on the moulding machines not included in the conveyor plant.

The moulding-machine hoppers are of the breeches type, there being seven hoppers feeding fourteen moulding machines. Very rigid sand control is exercised, and samples are taken every fifteen minutes. The permeability, moisture and bond strength are graphed up on a large blackboard, and the appearance of the castings is eloquent as to the wisdom of the very rigid control exercised, which on first sight might almost appear exacting.

A small laboratory is housed adjacent to the conveyor plant, and constant checks are taken

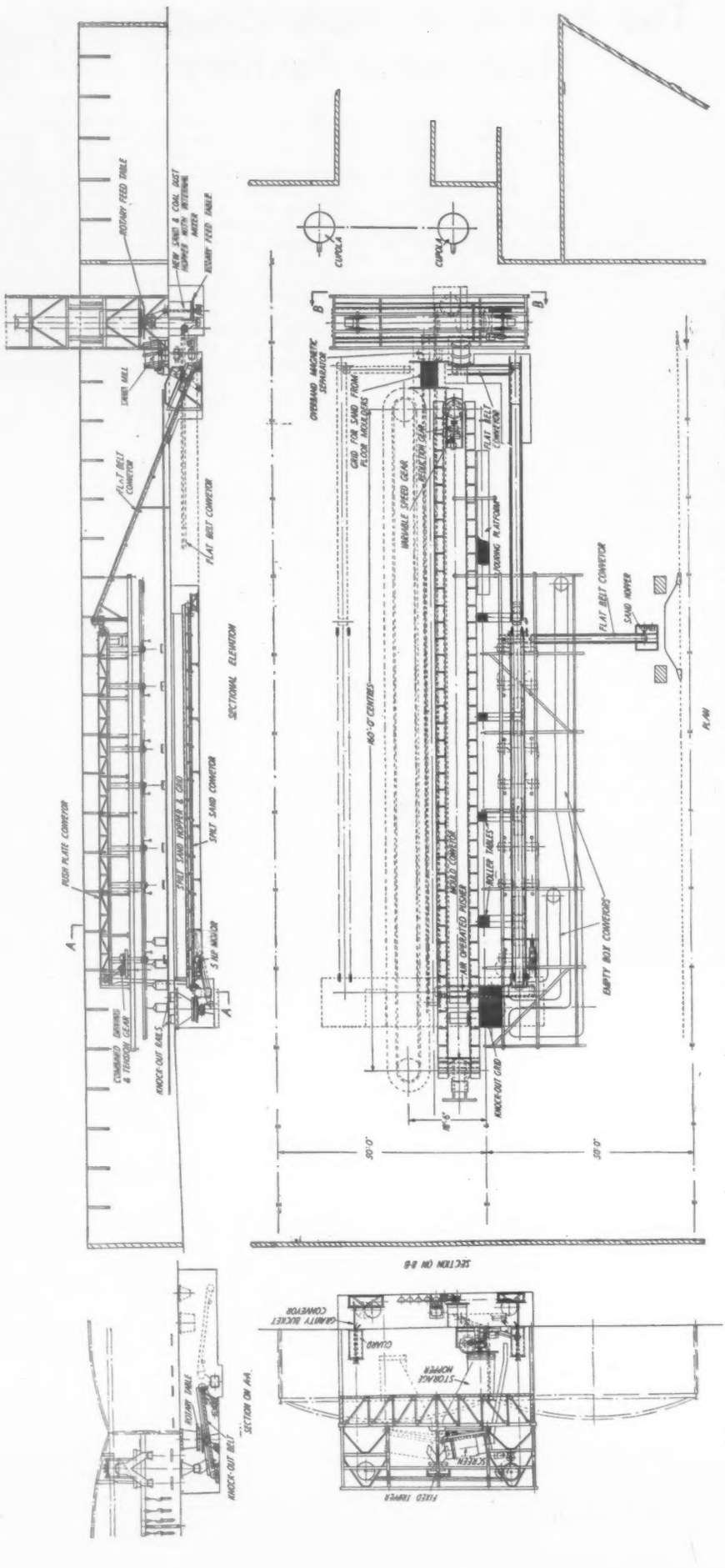

FIG. 1.—LAY-OUT OF THE MECHANISED FOUNDRY OF THE PARKINSON STOVE COMPANY, LIMITED, AT STECHFORD, BIRMINGHAM.

only of sand, but of the metal, from the nt of view of both fluidity and analysis. The nd testing equipment is that of a type mmonly used in America, and manufactured by Harry W. Dietert Company.

Moulding Stations

The hoppers previously mentioned are built of ut steel plates, and are so designed that there upon it. The placing of the machines between the mould and the pendulum conveyors, and of the gravity feed conveyors between the machines, has much to commend it. The provision also for supplying the non-mechanised section of the foundry with sand is an excellent feature, as is the provision of a grid feeding on to the main return-sand belt, so that ordinary foundry sand can pass through the system. The erection of

The writer would have liked to have given some time to descriptions of various other plants which he saw, and it would appear that the Parkinson engineers have paid particular attention to conveyorisation. The most interesting development seen was an automatic enamel spraying and drying machine, which was completely developed, designed and constructed by the company. It is believed to be the only one of

FIG. 4.—VIEW SHOWING POURING STATION AND INCLINED BELT FEEDING THE PUSH-PLATE CONVEYOR.

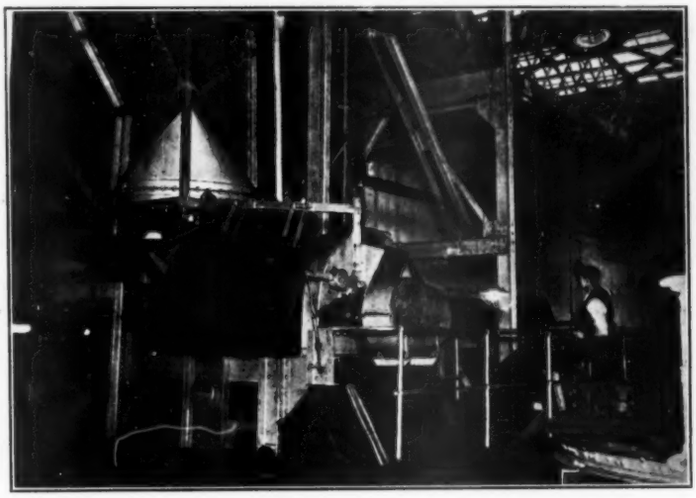

FIG. 5.—MORRIS CONTINUOUS SAND MILL, WITH SUPPLY HOPPER.

is a minimum amount of bridging. The gates at the base of the hopper are of the double swing type, and are quite normal in design. The moulding machine plant has been chosen to give the maximum amount of elasticity of output, and consists of seven pairs of machines. There are four Foundry Equipment F.E.3 hydraulic machines and two B.I.C. electro-magnetic machines, and it is interesting to note that, after due consideration, the management, in order to gain the maximum flexibility, decided that with the rest of the machines, the foundations would be made in such a manner that machines of various sizes and types could be placed in operation on the plant with very little delay. This, it is thought, is a most unusual feature, and was adopted to obviate the necessity for making the tremendous number of new patterns which would have been necessary had this scheme not been adopted. The spacing of the machines can be noted from Fig. 1, and it will be seen that there is a short length of roller track on which the moulds are cored and closed up before being finally placed on the main conveyor. The boxes are all made in the Parkinson foundry, and are of cast iron. It has been found that due to the excellent lay-out, the pushers at the knock-out and the return pendulum box conveyor, there is little actual manual handling, and therefore the necessity of using the lightweight boxes was not so pronounced.

Mould Conveyor

The mould conveyor runs between 160-ft. centres and is made up of cast-iron plates 8 ft. 11 in. long, 2 ft. 6 in. wide, set at 4 ft. 2 in. centres. These plates are all grooved, and facilitate gas release from the drags. The speed of the mould conveyor is controlled by a variable gearbox and can be varied between 8 and 16 ft. per min. With the present output, it is necessary to keep the conveyor running at nearly its maximum speed, and the pourers have no difficulty in coping with it. The moulding boxes are clamped, so that the "weighting" of moulds is eliminated.

General Considerations

Regarded as a whole, the scheme has responded very satisfactorily to all the demands placed the tunnel over the main cooling section of the mould conveyor does much to minimise fumes and steam production, and the atmosphere of the unit is consequently remarkably clear.

Another rather unusual feature is the incorporation in the tunnel of a photo-electric cell which automatically records on an indicator the number of moulds produced.

The foundry can be considered of the intermediate type, *i.e.*, that the percentage of cored to uncored work is in the nature of 50/50. A considerable amount, however, of highly-cored work, such as burners, gas rails, etc., is done, although there is a large output of light castings in which no cores are used. There are a number of master switches placed around the plant for instantly stopping all machinery.

The general lighting in the foundry is effected by Parkinson high-pressure gas lamps, designed to give an overall illumination of 10 ft.-candles. For local lighting, such as at various points round the conveyor unit, electricity is used.

Owing to limited space, it is impossible to give any description of the other departments in the works, although they exhibit many most interesting features. In the core shop, extensive use is made of core-blowing machines, and three different types are in operation, *i.e.*, Constructional Engineering Company, "Rocket" and Badische.

Because a considerable proportion of the castings have to be vitreous enamelled, great attention is paid in the fettling shop to surface preparation, and all castings which have to be enamelled are sand-blasted. There is a variety of machines, including Gutmann shot-blast rotary tables, "Wizard" airless shot-slingers, and also a new Badische airless shot-slinging rotary table, which was specially developed by the Parkinson engineers in conjunction with the Badische Company of Durlach, Germany. To ensure satisfactory enamelling, it is essential that a very close control be maintained, and the slightest surface defect or inclusion is sufficient to give rise to trouble. All castings are numbered and dated, so that, should the enamelling department experience any such difficulty, the matter can be traced immediately.

its kind in Europe, and it seems almost human in operation.

Acknowledgments

The writer very sincerely thanks Mr. Colley, Mr. Todd and the various departmental managers for the courteous reception accorded to him and for the very considerable help given in the preparation of this article.

Extensions at Glenfield's

NEW FOUNDRY AND OFFICES

Recently, in the presence of a number of delegates to the International Engineering Congress, held in Glasgow, a new brass foundry at the works of Glenfield & Kennedy, Limited, of Kilmarnock, was officially declared open.

The new foundry consists of two bays, the one used for sand moulding and metal stores, and the other for chill-moulding, cleaning and dressing with four shop and pattern stores at one end. The moulding bay is 222 ft. long by 48 ft. wide by 24 ft. to the eaves, with a span roof practically all glass, and having a large curved ridge ventilator 204 ft. long. The auxiliary bay is 167 ft. long by 37 ft. 6 in. wide by 18 ft. to the eaves, with a pattern store adding 49 ft. to the length.

The foundry is equipped throughout with Vectair heating and ventilating units. The plant includes a 7-cwt. capacity August Simpson sand mixer, with bucket-loader aerator, magnetic moulding machines, supplied by B.I. Cables, Limited, 5-ton Morris electric overhead travelling crane, Pneulec drying stove 12 ft. by 18 ft. by 8 ft. 3 in. high; 2-ton Stein & Atkinson oil-fired rotary furnace; a battery of 400-lb. Morgan coke-fired tilting furnaces, also Morgan coke-fired lift-out crucible furnaces, core-drying stoves, grinders, weighing machines, etc. Twenty moulders' benches and tubs are provided for moulding small work, the total number employed being 70 male and 10 female workers; the latter are engaged on the production of cores.

A new office extension at the north end of the existing building was also opened.

Symposium on Non-Ferrous Casting Alloys

CONFERENCE PAPERS DISCUSSED AT BRADFORD

One of the Technical Sessions at the Bradford Conference of the Institute of British Foundrymen was devoted to the presentation and discussion of three Papers dealing with non-ferrous metals and alloys. Mr. W. B. Lake (Senior Vice-President of the Institute) occupied the chair. Both the French Exchange Paper by Monsieur Gaston G. Gauthier and the German Exchange Paper by Herr G. Gürtler dealt with aluminium casting alloys, while Mr. J. E. Newson's Paper was concerned with high-strength brasses. All three Papers were published in our issue of June 16, 1938.

Heat-Treatable Aluminium-Silicon Casting Alloys

Mr. Gauthier's Paper was introduced by MR. V. C. FAULKNER (Past-President), who reminded the meeting that it was one of a series of foreign Exchange Papers. The first Exchange Paper was presented to the Institute in 1921, at a meeting held in Blackpool; it was contributed from America, and had dealt with electric furnaces. The exchange system was maintained between England and America for a number of years, and subsequently had spread to almost all the industrial countries of the world. He attributed a great importance to the system, because no country had a monopoly of brains, and some countries progressed on distinctive lines. Mr. Gauthier's Paper, for example, showed that progress in France in connection with the alloys discussed in the Paper was on lines rather different from those followed in this country.

In the translation of the Paper it was decided to state the figures in the metric system because of the very small differences noted between them in some cases; if the results were expressed in tons per sq. in. instead of kg. per sq. mm., the differences in some cases would be almost imperceptible. If it were borne in mind that 18 to 20 kg. per sq. mm. was equivalent to about 12 tons per sq. in., one would get a better idea of the contents of the Paper than by translating each figure.

Aluminium Casting Alloys

HERR G. GÜRTLER, in presenting his Paper, first conveyed to the British foundrymen the hearty greetings of the Technischer Hauptausschuss für Giessereiwesen, and of all their German colleagues. The results of the investigations presented by Mr. Gauthier, he continued, corresponded exactly with those made in the researches of the metallurgical laboratory of the Metallgesellschaft A.-G. In Germany, the usual amount of the Mg content was 0.4 to 0.5 per cent., producing a higher yield point, tensile strength and Brinell hardness than the alloys with a smaller addition of magnesium as used in France. On the other hand, according to the observations of Mr. Gauthier, the elongation decreased.

The heat-treatment consisted in annealing at 530 deg. C. for a period of from 3 to 4 hrs., quenching in water at room temperature, and age-hardening at 150 deg. C. for 20 hrs. The results obtained with specimens cast in the manner described by Mr. Gauthier were as follows:—

	Kgs. per sq. mm.	Tons per sq. in.
Yield point.. ..	22 to 28	13 to 18
Tensile strength ..	25 to 32	16 to 20
Brinell hardness ..	80 to 100	—
Elongation	0.5 to 4.0 per cent.	

According to the German observations, the fatigue strength was not influenced by the magnesium concentration. It was supposed that the variation of the fatigue strength with the Si content was influenced, not only by the appearance of the silicon primary crystals, but also by the variation of the kind of solidification with the different Si contents.

No difference in the effect of manganese or cobalt on the mechanical properties could be observed. A microscopic difference was found between the two crystals. The crystal containing manganese formed primary dendrites in the typical shape of "Chinese script," whilst the crystal containing cobalt solidified a little more in the shape of needles in the same time with the Al-Si eutectic.

Advantage of Eutectic Alloys

A considerable advantage of the eutectic Al-Si alloys over the Al-Cu, Al-Mg and other alloys with a long solidification range was that they showed the possibility of carrying out the heat-treatment of large castings in the same manner as that of test specimens without danger of deformation or cracking. Certain well-known castings, for instance, must be quenched in boiling water in order to reduce the rate of cooling.

The conditions for the production of a gas-free casting were (1) the preparation of a de-gassed melt by treating with salt and allowing to stand, and (2) the avoidance of the absorption of gases when filling the mould by lowering the pouring temperature and shortening the length and time of flow.

The investigations on the effects of the addition of titanium on the fatigue strength were being continued, and the results obtained so far did not differ from those given in the Paper.

DISCUSSION OF THE EXCHANGE PAPERS

Practicability of Double Treatment

MR. W. WEST (Leyland Motors, Limited) said that the Papers by Mr. Gauthier and Herr Gürtler gave British foundrymen much useful information, for they indicated investigations in a direction different from that in which we in this country had been working, and afforded British workers opportunities to modify their line of attack in their researches on the alloys concerned.

Those who were working with aluminium alloys already knew the possibilities of modification by sodium treatment and some of the benefits to be derived by the additions of special elements like titanium, magnesium, etc. The question which arose in the minds of managers of aluminium foundries was whether the double modification as suggested in Mr. Gauthier's Paper did not over-step the limits of foundry working. Those who had tried modification in practice were more or less convinced that the single treatment was sufficient to go on with.

Regarding the fatigue figures as given in Herr Gürtler's Paper, these were very interesting and had promise of some great usefulness. Could the author of the Paper add to this information whether such alloys had been used in any extensive way for the production of castings which had been subjected to stress conditions in service? Those who had had extensive experience in magnesium alloy castings operating under conditions which could not be reproduced in the laboratory had found that fatigue figures were rather misleading.

Gas Removal

Discussing the removal of gases from molten aluminium alloys, Mr. West stated that he was familiar with a similar process which had been developed by the British Non-Ferrous Metals Research Association, but could Herr Gürtler indicate how far his methods had been successful in actual operation in the foundry? It seemed to be necessary that any method of gas removal should be of such a character that it could be applied by the ordinary man in the foundry.

Mr. West stated that Herr Gürtler was to be highly praised for the manner in which he had delivered his Paper in English, and more particularly for his excellent ability in dealing with the discussion in the same language.

High Casting Temperature Queried

MR. N. C. ASHTON, referring to Mr. Gauthier's Paper, asked why the aluminium-silicon alloy test-bars dealt with therein were poured at a temperature between 700 and 720 deg. C. He had wondered why it was the practice to pour the high-silicon alloys at so high a temperature, because with other types of alloys he had obtained better results when casting at a temperature of about 650 deg. C.

Discussing Herr Gürtler's reference to modification of alloys by means of titanium—though it was in effect a grain size reduction by means of titanium, and could hardly be described as modification—he suggested that a combination of manganese and titanium would be more effective. He had used manganese and titanium in ordinary normal silicon alloys—not sodium-modified—and had effected improvement, not necessarily in tensile strength, but in machinability. The photograph of slip bands in Fig. 7 of Herr Gürtler's Paper was a very good example.

Having had some experience of 10 per cent. zinc-aluminium alloys, he asked if Herr Gürtler could confirm that they were quite good from the point of view of corrosion resistance, and whether he supported the allegation that the zinc-aluminium alloys were hot-short. Was hot-shortness the effect of annealing in 3L5 alloy alone, and if so was it due to the copper addition? The latter was probably the reason, because he did not think the aluminium alloys with zinc alone were necessarily to be condemned from that point of view.

Gas Elimination

MR. S. H. RUSSELL (Past-President) commented that one of the great problems of the aluminium founder was to eliminate gases, which, unfortunately, went into solution in the molten aluminium. The method in Herr Gürtler's Paper of de-gassing by lowering the temperature very slowly and re-heating rapidly was new to him, and he asked for some elaboration of it. He had always understood that when once an aluminium alloy was badly gassed it was practically ruined, unless it was subjected to modification. (In making that remark he had in mind the "Y" alloys rather than the silicon-aluminium alloys.)

The influence of titanium on aluminium alloys interested him particularly, because he had been studying a similar application to cast iron, and he asked how Herr Gürtler added the titanium to the aluminium alloy to give the beneficial results indicated in the Paper, because it had been found most difficult to add titanium to iron satisfactorily. The research had been complicated and disappointing in dealing with cast iron, because, although everything indicated that the titanium should appear in the iron, frequently it had got into the slag, and there was not sufficient in the iron to give the beneficial effect which undoubtedly could be obtained if it were really there.

Commenting on the statement in the summary of the Paper that the removal of gases from the melt was best effected by a combination of salt treatment and standing in a neutral atmosphere, he asked how that neutral atmosphere was to be obtained in commercial practice when handling pots containing, perhaps, 50 or 60 lbs. of molten aluminium. He asked whether the salt was merely placed on the top of the pot (it

was stated in the Paper by Mr. Gauthier that the bath of molten metal was provided with a surface layer of 0.3 per cent. of a mixture of 66 per cent. NaCl and 33 per cent. of NaF as soon as its temperature reached 750 deg. C.), or whether it was stirred in. If the latter were the practice, was the salt stirred in at an early stage, that is as soon as the metal was molten?

MR. F. HUDSON said that the information given in the Papers by Mr. Gauthier and Herr Gürtler was so well expressed that it would prove of great value to the practical man. He was particularly interested in the very simple way in which Herr Gürtler had shown the effect of gases in light alloys. To the average foundrymen the effects of gases in metals were rather complicated, but from a reading of Herr Gürtler's experiments one could readily understand what was meant, and the members were indebted to Herr Gürtler for that information.

With regard to degasification being brought about by allowing the metal to stand after treatment, the graphs in the Paper showed the time allowed for small experimental melts, but he asked what was the approximate time that larger foundry heats should be allowed to stand.

Standing Time for Modification

MR. W. N. COOK, B.Sc., after congratulating the authors upon their Papers, agreed with Mr. Ashton that in the foundry it was customary to cast the alloys at a temperature between 650 and 670 deg. C., and said that in practice quite good results were obtained. Quite recently test-bars of ordinary Alpax (known also as "L33") gave figures between 11.3 and 12 tons per sq. in. Supporting Mr. Hudson's request for information as to the length of time during which the metal should be allowed to stand after single modification with sodium, he said that in the foundry a 100-lb. pot would stand for possibly half an hour.

When a metal was allowed to become too hot, the furnaceman would cool it by inserting a gate, detached from a previous casting, and the amount of gas that was evolved when the gate entered the metal was amazing. There was no doubt that the cooling action of the gate caused a considerable release of gas, which was evolved in a huge bubble.

Originally, sodium was used for modification, and there had followed a large number of Patents involving the use of complex salts and other things, but in England foundrymen had reverted to the original sodium modification, which was found to be most satisfactory. He had found that about 1 oz. of sodium to a 70-lb. pot of aluminium was a satisfactory amount. He asked what was the practice in German foundries.

Relative Casting Properties

DR. L. B. HUNT said that the Paper by Mr. Gauthier indicated the very great advance that had been made by the development of the heat-treated aluminium-silicon casting alloys over the previously-known "as-cast" aluminium-silicon alloys. That was a very important advance, and he believed that because of it the future would see quite an extension of their use in the engineering industry.

Commenting on the statement in Mr. Gauthier's conclusions that the heat-treatable aluminium-silicon casting alloys possessed casting qualities almost equal to those of ordinary aluminium-silicon alloys, although surpassed by certain alloys containing copper and titanium, he said one would have thought that any aluminium-silicon alloy would have much better casting properties than any copper-containing alloy. Therefore, he asked if Mr. Gauthier would elaborate that point.

Dealing with Herr Gürtler's interesting survey of recent German researches, he commented upon the method of de-gassing by means of a salt flux and a neutral atmosphere such as nitrogen or CO_2, and suggested that Herr Gürtler was a little unfair to British research, because he believed Hanson and Slater, at the British Non-Ferrous Metals Research Association (and not Dr. Scheuer) had advised that method and had explained its working by the breaking down of the oxide film.

Vote of Thanks

Finally, DR. HUNT proposed a hearty vote of thanks to the authors for their Papers, and expressed appreciation particularly of the fact that Herr Gürtler had come to this country in order to present his Paper personally.

MR. F. HUDSON seconded the vote of thanks, which was accorded with acclamation.

The CHAIRMAN (Mr. W. B. Lake) expressed appreciation of the greetings conveyed by Herr Gürtler on behalf of his colleagues in Germany, and said that the British foundrymen heartily reciprocated; he asked Herr Gürtler to convey their good wishes to his German colleagues.

MR. FAULKNER said that he hoped to meet Mr. Gauthier personally in the near future, and would have pleasure in telling him that his Paper had been well received and was much appreciated. He confirmed the statement by Mr. Ashton that, according to the British literature, the pouring temperature of the aluminium-silicon alloys was about 650 deg. C., and said that the temperature of 720 deg. mentioned in Mr. Gauthier's Paper seemed somewhat high.

AUTHOR'S REPLY

HERR GÜRTLER, replying to the discussion on his Paper, said that modification by means of sodium was carried out at many foundries in Germany, and no great difficulties had been experienced with it. Degasification by means of metallic sodium alone was very slow, however, and in the great weights of metal dealt with in foundry practice the process was accelerated by the addition of salt. Crucibles containing 80 or 100 kg. of metal would degasify sufficiently if they were allowed to stand for 15 or 20 mins.

Experience of the addition of magnesium and zinc to aluminium casting alloys was not yet very great in Germany, and the results he had given were the outcome of laboratory experiments. He supposed that those alloys were not very good from the point of view of hot-shortness, due to the great rate of solidification by the sub-eutectic composition. Experiments had been made on anodising them. However, he believed that such alloys would be found to be useful for small castings, in which the extension requirements were small and where a good surface was required.

He agreed with the view that the casting temperatures given by Mr. Gauthier for the heat-treatable aluminium-silicon casting alloys were rather too high, and said that in Germany it had been found advantageous to lower the casting temperature a little. But the lowest temperature that could be used for aluminium-silicon alloys in the foundry was about 700 deg. C., because at lower temperatures the properties of the metal were not such as would allow adequate feeding of the castings. With very large castings it was necessary to use temperatures as high as 750 or 770 deg. C. However, the problem of lowering the casting temperature was bound up with the form of the mould.

Replying to the question as to the method of introducing titanium into aluminium alloys, he said that small pieces of an alloy of aluminium with 20 per cent. of titanium were added to the melt, so as to produce an alloy having a titanium content of 5 or 6 per cent. The temperature must be very high—about 1,200 deg. C. Then small pieces of the alloy containing 5 or 6 per cent. of titanium were added to the melt of the casting alloy; in that way the final alloy having the required content of titanium was produced. The titanium was absorbed at a temperature of about 800 deg. Another method consisted in introducing the titanium during the electrolysis process by means of TiO_2.

In the degasification process, a small amount of salt was melted with the metal in the crucible. Then a layer of salt was deposited on the surface of the metal, and subsequently it was allowed to stand. The improvement of the machining properties of the alloys was a difficult problem, and he suggested that the most advantageous method of dealing with it was to make a careful choice of the tool steels used for machining.

MR. ASHTON commented that manganese helped, in his experience.

Some Physical Factors in Casting High-Strength Brasses

The discussion of the Paper by MR. J. E. NEWSON was opened by MR. F. HUDSON, who said that foundry practice was a gigantic jig-saw puzzle, and Papers such as that by Mr. Newson could be likened to the pieces which worked into the picture. Until we knew and could recognise the characters of all the pieces, we could never solve completely the many problems with which we had to contend. The Paper was very refreshing, for it contributed pieces to the jig-saw puzzle in no small measure.

Conductivity of Mould Materials

Commenting on the statements in the Paper concerning the heat conductivity of mould materials, and the reference to some of the work which he had carried out some years ago, Mr. Hudson said that that work had been carried a step further by independent investigators. He mentioned particularly that C. A. Parsons, of Newcastle-upon-Tyne, had taken out a Patent* for a similar process, quite independently, and were actually using this in foundry practice. Admittedly they were using it on cast iron; they had found it to be very beneficial in the making of large grey iron castings, particularly where sections varied.

At the risk of appearing greedy, he asked for Mr. Newson's comments on the fluidity or "life" of the high-strength brasses, for that was a phase about which a good deal more information was needed. In the course of some work he had carried out a few years ago on fluidity he had been interested to note that some of the non-ferrous alloys had actually much less "life" than ordinary cast iron. Phosphor-bronze, for instance, had given a much lower "life" test than ordinary cast iron, although it had a much more searching action on the mould. That brought into the picture factors of surface tension and other conditions, and he felt that work in this connection could very profitably be continued.

Finally, he expressed the hope that further Papers of the kind presented by Mr. Newson would be contributed, in order that the facts should be made available for reference.

Controlling Grain Growth by Chromium

MR. J. E. O. LITTLE asked if Mr. Newson could give information on the control of the grain growth of high-strength brasses by chromium instead of iron. Some work had been done, he said, particularly by Gonser and Heath, in which 0.17 per cent. of chromium was claimed to inhibit grain growth altogether. So far he personally had tried only one experiment, and in that experiment the grains had certainly grown. In this, however, it was found that the chromium had not gone into solution properly, so the experiments would be continued.

MR. H. TAYLOR asked whether small additions of nickel, up to 1 per cent., lowered the tensile strength of high-tensile brass, in Mr. Newson's experience. His own experience was that such additions of nickel did lower the tensile strength, though they might increase the elongation.

Latent Heat and Melting Costs

MR. S. H. RUSSELL (Past-President) said he had never realised so clearly, before reading Mr. Newson's Paper, the importance of latent heat

* British Patent 470,972.

in regard to melting costs. He had always imagined that aluminium alloy was melted in the foundry more cheaply than Admiralty gunmetal; but it seemed that in an oil-fired tilting furnace the consumption of oil during the melting of 250 lbs. of aluminium was about the same as the consumption in melting 650 lbs. of gunmetal (which was of about the same bulk), the latter to be cast at 1,150 deg. C. He would take care to bring that fact to the attention of his costing department. It emphasised the great importance of giving close consideration to the factors discussed in the Paper.

High-Tensile Brass Casting

Commenting on the cooling curve in Fig. 1, he said he did not understand fully how it was made up, for the curve was so remarkably horizontal in the early part of the cooling range. A period of about 390 secs. had elapsed during the reduction of the temperature from about 902 to 890 deg. But he could not reconcile the other figures with the seconds. Many minutes, and probably three-quarters of an hour, must have elapsed before the temperature of the metal had been reduced to 300 deg. C., unless it was cast in thin sections. In his very limited experience of high-strength brass, the thermo-couple and the immersion type of pyrometer were extraordinarily reliable. Some 15 months ago, when dealing with a contract for Admiralty gunmetal and a small quantity of high-tensile brass, he had first had a talk with a Past-President of the Institute, and had then cast some test-bars, each one of which had a tensile strength of 42 tons. On the advice of that Past-President, 30 cwts. of castings were made, using the thermo-couple, and no trouble at all had been experienced. On the other hand, in dealing with a high tin-content phosphor-bronze some trouble had been experienced, although he had not expected trouble.

There was a great deal of interest in Mr. Newson's explanation of his conception of the manner in which the metal entered the mould, and the formation of the tenacious film of aluminium oxide on the surface, which protected the metal, provided the metal was not broken up too much by turbulence; the result was beneficial, and a smooth surface of the golden or yellow colour was produced. He personally had succeeded in achieving that result in the very small quantities of material he had handled.

The problem was extraordinarily fascinating, for different conditions arose with each different alloy. Mr. Newson's contribution, dealing with one of the most difficult alloys to manipulate, was indeed valuable.

MR. T. HENRY TURNER, M.Sc. (Doncaster), recalled discussions in the Institute concerning the raising of the status of the foundry industry, and said it was clear that the status must be raised if foundry moulding materials were to be understood in the manner indicated by Mr. Newson's Paper. When such matters as the specific heats and conductivity of the individual constituents in moulding sands were being studied, the Institute was definitely moving in the right direction.

AUTHOR'S REPLY

MR. NEWSON replied to the discussion. After expressing appreciation of Mr. Hudson's remarks, he said he had purposely avoided the problem of fluidity, because it had been dealt with so fully by Dr. C. H. Desch in the third Edward Williams Lecture delivered to the Institute in June, 1937.

Dealing with Mr. Little's reference to the control of grain-growth by means of chromium, he said the original intention was to control the grain-growth of alloys which had been subjected to cold work, followed by annealing. In view of the success of this work he had tried some experiments on cast alloys, but it had proved to be very difficult to get a chromium-copper alloy to dissolve satisfactorily in the high-strength brasses. In the Paper he had mentioned the use of materials other than iron which would have a refining action, and he had had chromium in mind then. He had realised that other additions might have a refining action, although he did not know whether the action was precisely the same as the iron-rich phase in the manganese bronzes. The photographs in Fig. 2 of the Paper were intended to emphasise the important influence of iron, which was more easily introduced than chromium.

Balanced Additions

Discussing Mr. Taylor's question concerning the effect of nickel, he said that in considering high-strength brasses one must take account of all the elements present, and must maintain a correct balance of the various metals added. He thought that in certain alloys, 1 per cent. of nickel would not have a marked effect on the tensile strength, but in a normal manganese bronze 1 per cent. of nickel definitely effected general improvement; a higher percentage of nickel effected even greater improvement, provided a correct balance was obtained with the other metals in the alloy. "Turbadium," an alloy introduced about the year 1910, contained 2 per cent. of nickel, and it was the most successful alloy introduced up to that date for resisting erosion.

Latent Heat and Melting Costs

As to the effect of latent heat on the cost of melting, he assured Mr. Russell that the figures given in the Paper in that connection had been checked over quite a long period of working, making the ordinary "21.5" alloy, and it was true that as much oil was required to melt 250 lbs. of aluminium as was required to melt 650 lbs. of gunmetal. Incidentally, he pointed out that a burn caused by aluminium alloy was often far more severe than a burn caused by gunmetal or bronze, for the reason that more heat was stored in the metal.

Differential Cooling Curves

The differential cooling curve in Fig. 1, upon which Mr. Russell had commented, was presented in the recognised form. The thermo-couple was immersed in a crucible of metal, and the whole crucible, with the thermo-couple immersed, was allowed to cool very, very slowly in an electric or other suitable furnace. By means of a metronome or stop watches, the time occupied by the fall of temperature over a certain number of degrees was measured. In his experiments, the time interval was measured accurately for successive decreases of 10 deg. C., the temperature of any prolonged arrest being noted. The time intervals in seconds were plotted against temperature. During the fall from 910 to 900 deg. there was a long hold-up at 902 deg., and at 890 deg. the metal had held the temperature for 400 secs. Then there was a slight kick forward on the curve, because the temperature of the surroundings of the crucible had fallen slightly lower than the temperature of the metal in the crucible; thus, the rate of cooling was accelerated whilst equilibrium conditions were re-established. Any phase change should be marked clearly, and there was a well-marked point in the case of the manganese bronzes at about 450 deg.; but there were also other minor points on his curve which might be due to external influences.

Foundry Handling of High-Tensile Brasses

After congratulating Mr. Russell on the good results he had obtained with high-tensile brasses, without having previous experience, he said that sometimes foundrymen experienced trouble with such alloys because they did not understand the form of skim gate to use to prevent dross formation, etc.; further, it was necessary to use very generous heads in order to allow for contraction and for the very difficult pasty range. In large jobs the heads were always rod fed, but that was not so necessary in smaller jobs.

With regard to the surface film on the alloys, he said he had carried out a number of experiments with open moulds in order to study the flow of metal into the mould, and the reactions between the metal and the various types of mould materials and dressings. In very large jobs one could sometimes see the succession of lines, indicating the continual re-forming of the film. If the metal was poured without providing proper control at entry, trouble would be experienced, as zinc would be volatilised and, combining with oxygen of the air, would form zinc oxide, which, floating on the surface of the metal, could give rise to drossy, dirty patches when trapped.

On the motion of MR. W. B. SALLITT, seconded by MR. V. DELPORT, a hearty vote of thanks was accorded Mr. Newson for his Paper.

Non-Destructive Testing

MEETING ORGANISED BY JOINT COMMITTEE

The Joint Committee on Materials and Their Testing is organising a meeting, to be held on November 25 next, under the auspices of the Institution of Electrical Engineers, for the discussion of the subject of non-destructive testing. The subject has been divided into three sections: (1) magnetic and electrical methods; (2) X- and gamma-rays; (3) acoustical and general methods. Each section will be dealt with by authors representing respectively Great Britain, Europe and the United States.

Thus, magnetic and electrical methods will be dealt with in Papers by Dr. B. Berthold (director of the Reichs-Röntgenstelle, Berlin) and by Dr. A. P. M. Fleming and Mr. B. G. Churcher; X- and gamma-rays will be dealt with by Ing. J. E. de Graaf (of Philips' Gloeilampenfabrieken, Holland) and Dr. V. E. Pullin, while acoustical and general methods will be dealt with by Prof. Dr. Köster (of the Kaiser-Wilhelm-Institut für Metallforschung, Stuttgart) and Dr. S. F. Dorey. The experience and views of the United States of America will be presented in a joint Paper by Mr. N. L. Mochel (metallurgical engineer, Westinghouse Electric & Manufacturing Company, Philadelphia), Mr. H. H. Lester (senior physicist, Watertown Arsenal, Watertown, Mass.), and Mr. R. L. Sanford (chief of the Magnetic Section, National Bureau of Standards, Washington, D.C.).

In view of the authority of the authors contributing the Papers, and of the very topical interest of the subject, it is expected that the meeting will be of considerable importance. It will be held under the presidency of Dr. A. P. M. Fleming (President of the Institution of Electrical Engineers), and a general invitation to attend is extended to all those who are interested.

Book Review

Testing and Grading Foundry Sands and Clays. Published by the American Foundrymen's Association, 222, W. Adams Street, Chicago, Illinois. Price 4 dollars.

Seven years have elapsed since a revision of this well-known work was published. As readers are probably aware, it is compiled by the Committee on Standard Tests of the A.F.A. Foundry Sand Research Committee. The present edition—the fourth—has been enlarged, and contains details of many new tests for sands and clays. In all, 16 standard and 17 tentative standard methods are listed, as well as one recommended method. The material has been entirely revised throughout to conform to a standard outline and description at the end of the book. An extensive table of contents and a cross index of material for ready reference are also included. The flexible cover is specially prepared to resist dirt and to withstand rough handling in the shop office or laboratory.

English and American Steel-Foundry Practice*

By C. J. DADSWELL, Ph.D., B.Sc.(Eng), Ingénieur de l'Ecole Supérieure de Fonderie†

The steel-foundry industry in Great Britain is esentially of a jobbing nature, the existing foundries being of all sizes, with outputs varying from a few tons per week up to several hundred tons per week. There have been few British steel foundries laid out for specialised production of a limited variety of castings excepting in cases such as mine tub wheels, railway wagon components and wheels, some manganese steel specialities, some gear wheels and valve castings, and it is only recently that more elaborate methods of production have been introduced. In no case does the output of these specialities compare with the output obtained in the largest American foundries‡ devoted to the production of vast quantities of the same or similar castings.

The American steel-foundry industry is very much specialised, not only for the mass-production of machine-moulded castings but for types of castings of all sizes, and it is this specialisation that strikes one so forcibly during a visit to the steel foundries of that country. The cause and effect of this line of development make an interesting study. The cause was partly the size and geographical position of the markets and partly the cost and quality of labour available, particularly in the earlier days of the industry, whilst the effect has been a higher standard of quality and a decrease in the cost of production, which has been marked enough to be an important factor in the trend that appears to exist in America towards the greater use of steel castings at the expense of fabrication and other methods of manufacture. There are grounds for believing that an opposite trend exists in this country to-day, particularly in some branches of the electrical industry, which would seem to suggest that a co-operative effort is needed towards a higher degree of specialisation in production and a more active and organised propaganda amongst designers to meet the competition from outside the steel casting industry, a far more serious matter for the trade as a whole than rivalry within itself.

For the mass-production of steel castings the British industry has no plant really comparable to the larger ones in America, but latterly British steel foundries have tended to specialise in a modest way, and although the quantities involved, either for mass-production or for what one might term "specialised production in small quantities," are nothing like those obtained in the States, better production methods have been developed. They have usually been somewhat hampered in that quantities have not warranted special foundries or even full mechanisation, so that suitable compromises have been introduced as a development of the special lines already established.

There is in fact a tendency amongst all the larger British producers of steel castings to have one or more specialist lines with which to form a nucleus of production, to help them with their output of jobbing work, a policy which seems to offer the best prospects of success under our conditions, and which has some advantages over American methods by making our average outputs less variable with the fluctuations that can occur in specialised products. The principle is satisfactory if properly applied, but can lead to trouble with both types of product due to the antipathy that exists between the improvisation of the real craftsmen and the mechanical discipline so essential to specialist production methods. There is no doubt that the organisation of a large jobbing foundry is very much more difficult than that of a foundry devoted entirely to mass-production work.

It will be admitted that the British steel foundries have been slower in adapting their organisation for the "modest" or "semi-mass" production type of work, and in this respect been behind the British iron founding industry, which commenced on higher production bases somewhat earlier owing to its association with the motor-car industry which quickly learnt its lessons from American motor vehicle manufacturers.

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The method of recruitment for executives in British foundries has probably had some influence on the slow development of production methods. In America there was no doubt at one time a lack of skilled foundry artisans, and the executive positions were filled by a combination of foundrymen and engineers. In our country the recruitment of executives has in the past been almost exclusively from the ranks of moulders and patternmakers, who, whilst capable of producing the highest quality castings, are not always so receptive of the latest developments in science, engineering and management as the less specialised general engineer.

There is no doubt that in foundry management both an engineering and a metallurgical training are always an advantage, and the former is almost essential where mechanisation has been seriously developed. The lack of skilled artisans had also no doubt a direct influence on the earlier application of production methods and specialisation in America, in that means had to be found to make the product as far as possible independent of the skill of the workmen. Further, the tremendous rate of development of a great virgin country by a race that was progressive and enterprising almost to a fault, naturally led to intensive production beyond anything that had been heard of in the old world.

In certain cases a great improvement has recently been made in the rational organisation of British jobbing and semi-production work. This has been assisted by the introduction of planning sections, which are more or less elementary as compared with those in large mass-production factories but which do, to some extent, take the laying-out of the work and so on from the shop floor and place them more under considered office control. In the case of jobbing work and with keen and intelligent foremen it is neither desirable nor feasible to make the planning of production entirely office-controlled, but careful guidance on the part of those in charge enables the foremen to work out the final details to advantage and is a most useful educational force for them.

The technical aspect of the steel-foundry industries shows differences between the American and British methods, due to the factors which have already been mentioned as affecting the question of specialisation, and also due to variations in raw materials and the mechanical appliances which it is possible to use on jobbing and special production work. Other important factors are the psychology and traditions of the people and the standard of finish of the products required. The impression in this country is that buyers demand a better finish from British than from American steel foundries, but the author is of the opinion that present-day American castings are becoming generally equal in finish to our own, and in the case of some of the best specialised firms even better.

This improvement is largely due to the effect of the last depression, during which the American foundries sought to improve their products to gain customers and increased their expenditure on research, with a consequent improvement in their technique. Similarly, although less money has been spent in this country on steel-foundry research during the same period, the recent depression in our foundries has encouraged investigations to develop materials and methods which will cheapen production, whilst maintaining the standard in finish. Incidentally, this same depressed period in this country has diminished the number of skilled artisans available, by reduction in recruitment and by drift to the better paid and more secure sheltered trades, making it necessary for us to develop methods of production and organisation that can function with less dependence on the standard of labour.

Distribution and Organisation of the Industries

The remarkable amount of specialisation in the American steel foundries has already been mentioned. It does not follow that one parent company operates foundries throughout the country which in every case make the same products, but one finds the same castings being made in different parts of the country by different concerns. Their methods, however, are often very similar, even in detail, though the works may be far apart. This is partly due to the interchange of information, which in recent years has become more common, between manufacturers of similar castings. They realise that everyone benefits by such interchange, and that they have little to fear from distant competitors as transport costs safeguard their market. The spread of ideas is also fostered by the tendency for American executives generally to move about from one employer to another more than is usual in this country, and, their experience being specialised, they naturally move principally among the firms making the same types of castings. An example is the cast mill-roll, which is a highly successful specialised product made in just the same way in Pittsburg or Chicago, two centres for this class of casting, where the demand is large. Fortunately, the

* Paper presented at the Annual Conference of the Institute of British Foundrymen at Bradford last month.

† English Steel Corporation, Limited.

‡ The term "American" throughout this Paper refers either to the country or the people of the U.S.A.

interchange of ideas among British steel founders is far more frequent than it was only ten years ago and is bound to benefit everyone concerned.

In America one finds specialisation even in large castings, one example being that of rolling-mill equipment, the manufacturers of which plant operate their own foundries and produce perhaps several roll housings of over 50 tons weight per week. Fig. 1 shows two such housings which were cast and machined in England. The operation of their own foundries by firms of engineers is more marked in America than in England, particularly in the heavy industries. In this country, the demand for large castings for any one firm could not warrant a special foundry, and, in fact, no foundry could exist on an output of large castings only, so that in England it is found that large castings are made by foundries run in conjunction with steelworks, where the surplus output of the large open-hearth melting furnaces can be absorbed by the production of ingots for forging or rolling.

FIG. 1.—TWO ROLL HOUSINGS OF ENGLISH MANUFACTURE.

FIG. 2.—ENGLISH MOULDING UNIT FOR GREEN-SAND CASTINGS.

Moulding Technique and Materials

There is a marked difference in America and England regarding the categories of size and weight into which castings are divided for making in green sand, skin-dried or dry sand. There is also considerable difference in the kind of moulding mixtures employed for these different sands, the difference in material being most marked in the case of American dry sand, which with very few exceptions is of the synthetic type for all sizes of castings. Moulders' "composition" as used almost generally in this country for heavier castings is practically unknown, and there are fewer than half-a-dozen American concerns using chamotte "compo," a process which has recently been learnt in America from the Continent, but which is not likely to extend very much, owing to its higher cost compared with synthetic sand.

As for the difference in categories, one of the striking features of American steel-foundry practice is the extent to which green-sand moulding is practised. Apart from its being almost universally used for machine moulding, it is common to find jobbing castings up to five tons being made in green sand, and up to 25 tons by the skin-dried method. Nothing like the same proportion of green-sand moulding is done in England, although it is now coming into more favour, and the tonnage so produced is growing every year. A casting weighing five hundredweights is still considered a large one to make in green sand here, although castings up to one ton are made green in the foundry with which the author is connected.

A green-sand moulding unit for making steel castings weighing up to five hundredweights is shown in Fig. 2.

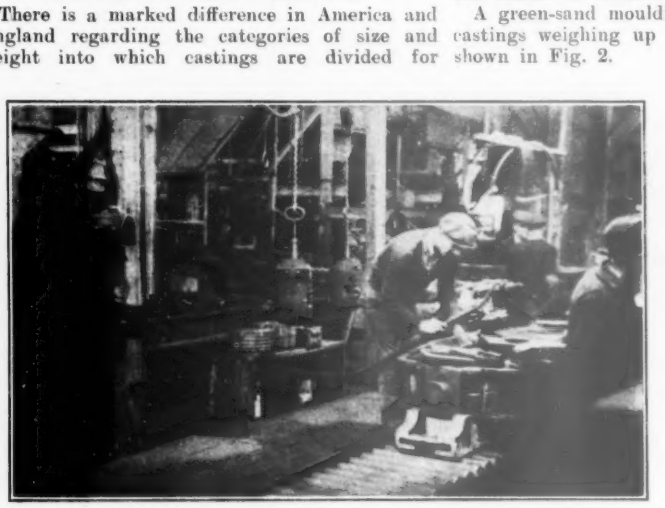

FIG. 3.—END OF AMERICAN GREEN-SAND MOULDING UNIT.

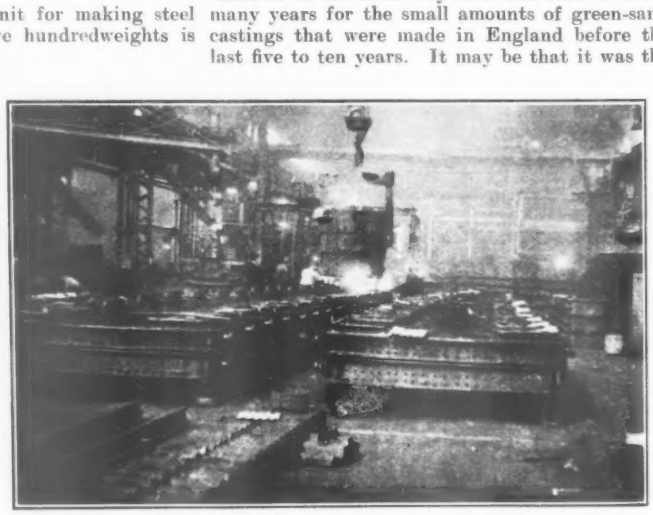

FIG. 4.—POURING AMERICAN GREEN-SAND CASTINGS.

The reason why green-sand moulding has developed to a far greater extent in America than in England, where for many years it was used in only a few foundries, is no doubt the large-scale production in America, as green sand is the only logical method for large outputs. Fig. 3 shows the end of a production line of an American green-sand moulding unit which produces over one hundred castings weighing approximately 750 lbs. each in less than eight hours, and Fig. 4 is a view of the casting floor with the moulds being poured.

Skin drying is an obvious development from green-sand moulding, as of course it has many of the same advantages, in that moulding boxes circulate more quickly and no drying stoves are required. It is, therefore, common to find American foundries making castings up to several tons in weight where there are no mould drying stoves.

The moulding sand mixtures for green-sand, skin-dried and also dry-sand work are practically all of the synthetic type, and are made from silica sand having varying small amounts of natural clay mixed with fireclays or bentonite, and in some cases one or more of the cereal binders. In America there is even less natural moulding sand available than in this country, and the author believes that before the last War a large quantity of Belgian sand was imported into America in the same way as it has been used for many years for the small amounts of green-sand castings that were made in England before the last five to ten years. It may be that it was the difficulty of obtaining this imported sand in America during the Great War that led to the rapid development of synthetic sand.

It is the rule rather than the exception to find some form of sand control in every American steel foundry, and particular attention is paid in

foundries working in green sand to obtain a high permeability figure, this being as high as 200 for backing sand. Table I gives the mechanical grading and chemical analysis of typical silica sands used in America and in England for making green and dry sand mixtures. The appearance of the sands at a magnification of 25 diameters is shown in Figs. 5 to 9.

The silica sand used in American dry-sand mixtures is somewhat coarser than that used in the green sand, and is in fact coarser than the silica sand commonly used in this country. The heaviest steel castings made in the synthetic mixtures compare very favourably in finish with our castings of equal weight made in "compo," and one wonders why synthetic mixtures have not been developed more in this country, considering the relatively high cost of "compo." In England synthetic dry sands mixed on slightly different lines have been used for lighter castings, which in America would more often be made in green sand. Belgian sands are also much used for dry-sand work, although the author is sure that no castings have been made in England, using Belgian sand, as heavy as some made in the country in which it occurs, where 50-ton and heavier castings are made. Examples of moulds for very large English castings made in "compo" are illustrated in Figs. 10 and 11. Fig. 10 shows a mill housing, similar to those seen in Fig. 1, and Fig. 11 the coring up of the mould for an 80-ton press casting. Its appearance when ready for machining is shown in Fig. 12. Incidentally a similar casting believed to be the heaviest steel casting yet made in England and weighing 120 tons, has recently been made in the foundry with which the author is connected.

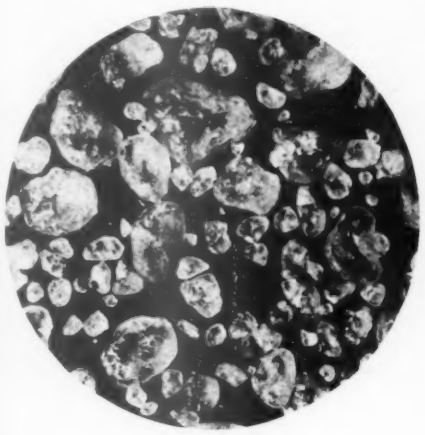

FIG. 5.—OTTAWA SAND. × 25.

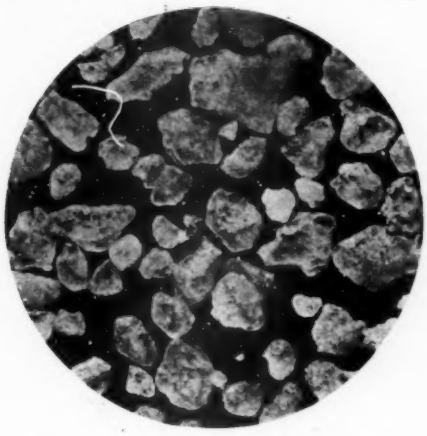

FIG. 6.—KINGS LYNN RED SAND. × 25.

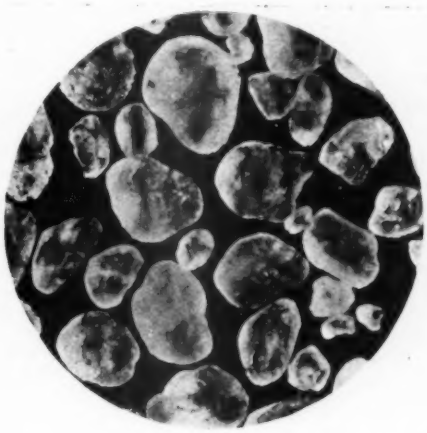

FIG. 7.—AMERICAN SAND (SOURCE UNKNOWN). × 25.

TABLE I.—*Typical Silica Sands Used in American and English Synthetic Green-Sand and Dry-Sand Mixtures.*

Source.	Used in.	Percentages on B.S.I. Sieve Nos.												Total sand grade.	Analysis.			
		8.	10.	16.	22.	30.	44.	60.	100.	150.	−150.	Silt.	Clay.		SiO_2. Per cent.	Fe_2O_3. Per cent.	Al_2O_3. Per cent.	Loss on ignition. Per cent.
For green sands—																		
Ottawa	U.S.A. ..	—	—	—	0.43	11.33	40.0	24.8	14.9	4.24	0.57	1.94	1.7	96.36	98.60	Trace	0.95	0.35
Kings Lynn ..	England ..	—	—	0.04	0.13	2.19	27.31	24.31	34.19	4.76	0.1	2.33	4.07	93.6	93.9	4.06	1.14	1.2
For dry sands—																		
X	U.S.A. ..	—	—	—	0.33	8.63	33.01	28.0	20.54	5.24	0.18	2.07	1.84	96.09	98.30	0.14	0.96	0.42
Venango ..	U.S.A. ..	10.0	3.0	7.4	9.4	18.5	27.8	10.3	3.7	1.0	0.06	2.98	5.45	92.98	96.10	0.57	2.03	0.85
Leighton Buzzard	England ..	0.34	0.21	1.75	8.35	31.3	44.9	10.43	2.27	0.28	0.1	—	—	—	99.1	0.43	0.32	0.2

At times, in order to increase the dry strength of the mixture for top parts, and also to prevent penetration of steel into cores, the American practice is to add silica flour to the mixture to close it up.

For the bonding of cores the American steel foundries use both proprietary brands of core oil and their own core binders made from linseed oil and cereal binders or resinous compounds and other known binders. A larger proportion of the steel foundries make up their own mixtures than is common in England, possibly again because their outputs are larger, and therefore their requirements of core materials can be more economically met than would be the case in many British concerns. The properties and application of cereal binders for binding both mould and core materials are better understood in America than in this country, and they are used more extensively. This greater use of cereal binders may be due to the fact that America is a large producer of cereals, and has therefore developed outlets for certain of the by-products, or perhaps founders demanded this material and developed it in collaboration with the producers. It is presumably due to the fact that proprietary core binders in this country have been easily available for the founder, that there has been less inducement for him to produce his own mixtures of binders.

In reviewing the moulding materials used in both countries, it is impossible to conclude without reference to cement moulding, which is so much under discussion at present. One American concern in particular has taken up this process with enthusiasm, and has obtained considerable success. Castings of a general jobbing nature are produced with comparatively good results, equal to those made by any other process. It is particularly interesting to note that steel castings up to about 50 tons in weight have been produced, and from the photograph of one of these castings the process appears to have been very successful.

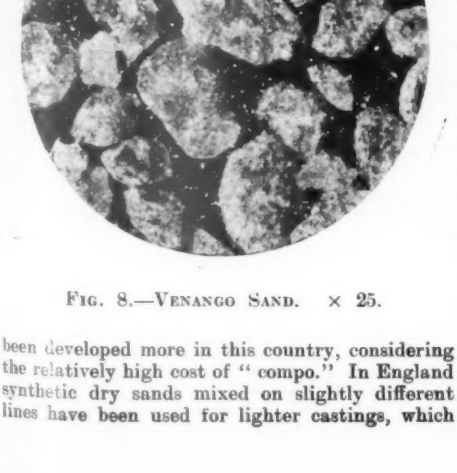

FIG. 8.—VENANGO SAND. × 25.

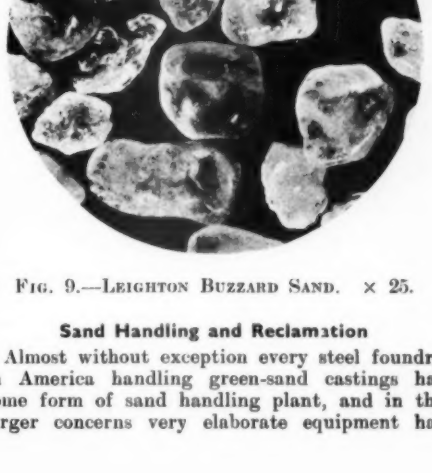

FIG. 9.—LEIGHTON BUZZARD SAND. × 25.

Sand Handling and Reclamation

Almost without exception every steel foundry in America handling green-sand castings has some form of sand handling plant, and in the larger concerns very elaborate equipment has

been installed. There are no comparable plants in Britain, for the simple reason that there are no concerns handling such large quantities of sand, but most steel founders will be familiar with the type of plant, having seen somewhat similar equipment in iron foundries, of which an increasing number have been equipped with handling facilities in the last ten years or so. Nearly all the steel foundries in Great Britain that are extending their green-sand practice have installed some form or other of handling plant, and that which was installed over 10 years ago in the foundry with which the author is connected, and recently completely modernised, is perhaps the largest of its kind in the country for a steel foundry. Fig. 13 is a view of one 15 ton per hour green backing sand preparation unit in this foundry.

Examination of American plants shows many attempts at satisfactory sand reclamation, and one finds both mechanical grading and air separation in operation. Latest opinion appears to favour mechanical separation of the undesirable from the desirable grain sizes, and most of the new plants being installed are based on this principle. A process of which more will be heard in the future, but which at present is in its infancy, is the use of a classifier pump for sand, which can be used in conjunction with the hydro-blast system of cleaning castings. This system of cleaning, which is still in the process of development, merits a brief reference. It is a combination of the hydraulic method, using water only, which received publicity some few years ago, but which was not found really satisfactory for cleaning steel castings, and the use of sand. The sand is entrained in a high-pressure water jet and projected at the casting being cleaned.

Figs. 14 and 15 respectively show the appearance of an American green sand before and after reclamation by air separation, and Table II indicates the grading of this sand before and after treatment. The particular foundry from which these examples were obtained operates on less than 10 per cent. addition of new sand and is producing regularly green-sand castings up to ½ ton in weight.

It is interesting to note that climatic conditions compel most of the steel founders in America to hold large stocks of sand during the winter months, owing to the fact that snow and frost make it difficult to obtain the sand from the pits. This means that the foundries must have sufficient areas available to store their sand.

FIG. 10.—"COMPO" MOULD FOR MILL HOUSING.

FIG. 11.—CORING-UP A "COMPO" MOULD FOR AN 80-TON STEEL PRESS CASTING.

TABLE II.—*An Example of American Green Sand Before and After Reclamation by Air Separation.*

Condition.	Percentages on B.S.I. sieve Nos.										Total sand grade.	Analysis.			
	16.	22.	30.	44.	60.	100.	150.	—150.	Silt.	Clay.		SiO_2. Per cent.	Fe_2O_3. Per cent.	Al_2O_3. Per cent.	Loss on ignition. Per cent.
Before reclamation.. ..	0.25	0.4	10.76	32.24	23.14	17.18	4.37	0.15	4.06	7.64	88.3	96.2	0.43	2.07	2.05
After reclamation	0.06	0.15	8.72	35.9	31.92	15.13	1.8	0.07	0.61	5.55	93.74	96.30	0.28	1.92	1.87

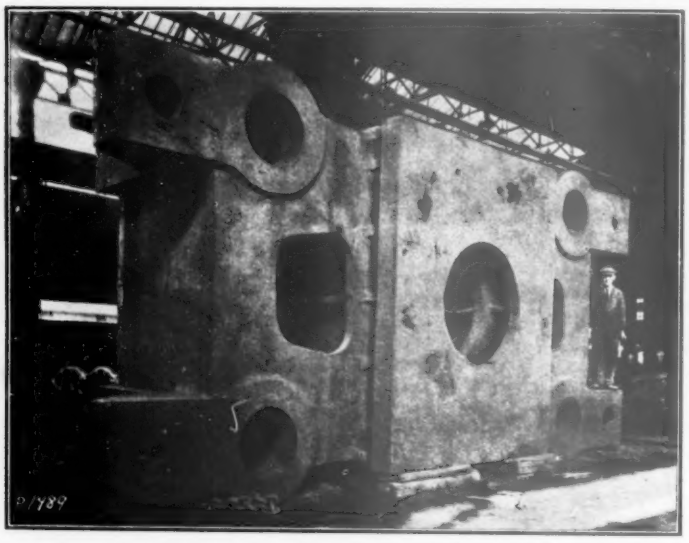

FIG. 12.—80-TON STEEL PRESS CASTING, READY FOR MACHINING.

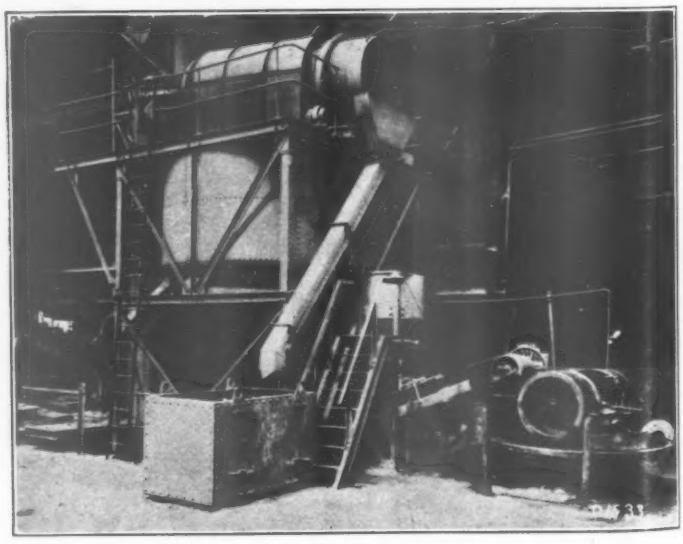

FIG. 13.—ENGLISH UNIT FOR PREPARATION OF GREEN BACKING SAND.

For High Quality Castings

The increasing demand for high-strength close-grained iron castings calls for improved metal. In comparison with the accepted standards of the past, the modern high quality casting requires lower total carbon and phosphorus, with a closer range in silicon. The Ironfounder can now meet this demand at a reasonable cost by the use of Stanton-Dale Refined Pig Iron.

Stanton-Dale is a pig iron of low total carbon, the graphitic carbon being uniformly distributed and of fine curly-flake formation. The close structure ensures remarkably high strength with good machineability, and Tensiles of 16 to 20 tons can readily be obtained when a proportion of Stanton-Dale Iron is introduced.

The use of this iron avoids the irregularities in structure which are sometimes observed when steel scrap has formed part of the charge.

The correct grade of Stanton-Dale Iron to use depends on the type and class of castings to be made. The Stanton Technical Service is available to advise on suitable mixtures.

Total Carbon from 2.6 per cent. upwards. *Analysis to individual specification as required.*

STANTON-DALE
REFINED PIG IRON

The Stanton Ironworks Company Limited, Near Nottingham

The Largest Producers of Foundry Pig Iron (for Sale) in Great Britain

and must be able to handle it. There being no such necessity in Britain, very few steel foundries here have facilities for storing such large quantities of sand.

American Moulding Practices of Particular Interest

Before leaving the subject of moulding, the author would like to mention certain practices in America which are unique, and for which due credit must be given to our American colleagues. Perhaps the most striking of all, and one of which many steel founders in this country have no doubt read or heard, is that of making cast-steel locomotive frames with cylinders and other attachments such as boiler saddles, and horn block guides cast integrally. These frames, water bottoms for tenders and other castings up to a maximum of about 90 ft. in length, are made in low-carbon steel, unannealed, and are machined on special machine tools. There are two large works belonging to the same company in America making these castings, for which the equipment and layout are so extensive, and the machine tools used for finishing are so specialised, that it is extremely unlikely that similar castings will be made in any other parts of the world. Particulars of moulding methods used have been published in the technical journals, so that there is no need to describe the entire process, but in a few words it consists of building up the complete moulds in dry-sand cores placed on specially machined steel jigs in moulding pits (a normal frame consists of 600 cores). In one of these works, six-wheeled bogie truck castings are rammed in green sand on a jolt-ram machine of 70 tons capacity with a machine table 22 ft. long, which is probably the largest jolt-ram machine in the world.

Steel Melting Units

The melting units used in America and Great Britain for the supply of steel for making castings are more or less similar, with the exception that there are now very few Tropenas plants in America, where the most common unit for the small foundries is the electric furnace, usually with an acid lining, as against the almost universal basic lining in this country. It has been suggested that the reason why the acid electric furnace is so much used in America is again the effect of the Great War, when it was difficult and expensive to obtain basic linings. It has been said that the American steel foundries using electric furnaces have produced some very bad steel in the past, but now, at any rate, their steel appears to be generally improved. The acid electric furnace produces a greater output at a lower cost price compared with a basic furnace of the same capacity, the steel having a fluidity which compares more favourably with Tropenas steel than does basic steel. This, together with its flexibility and probably also the availability of cheap electrical power, has no doubt led to the adoption of the acid electric furnace in the smaller foundries in preference to the surface blown converter.

For larger outputs both acid and basic open-hearth furnaces are used, commonly fired by oil or natural gas, occasionally by producer gas. The average capacity of the large open-hearth furnaces in foundries devoted entirely to the manufacture of heavy steel castings appears to be about 50 tons maximum, whereas, in this country, in steelworks making both steel castings and ingots, the larger furnaces are usually of 60 tons capacity. Smaller furnaces are of course used in both countries. The most common size of acid-electric furnace is about 6 tons capacity, there being of course both larger and smaller furnaces.

One might expect continuous casting systems with mechanical mould conveyors to be commonly employed in American production steel foundries, but this is not the case. The foundries having very large outputs of, say, five-hundredweight castings use open-hearth furnaces of approximately 30 tons capacity, and utilise extensive casting floors to accommodate the moulds for each charge.

Steel Specifications and the Use of Alloy Steels in Castings

Quite recently steel-casting manufacturers in both this country and America have been asked for, and have produced, qualities of castings of greater strength than the ordinary mild steel type to meet the demand of designers, and to meet the competition of articles made in other ways such as forgings, stampings and fabricated structures. The Americans have done more in

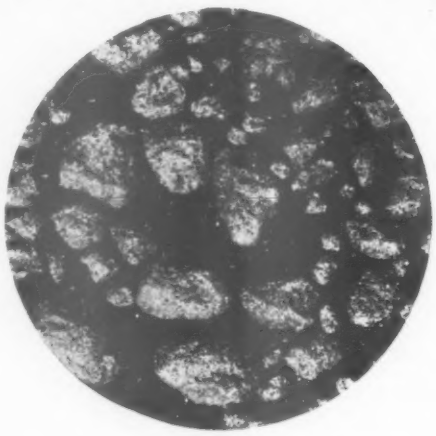

FIG. 14.—AMERICAN GREEN SAND BEFORE RECLAMATION. × 25

this direction, partly because their markets spread over a wider field and therefore offer greater opportunities, partly because of their enthusiasm for anything new which they pursue energetically, and partly owing to the incentive to regain markets lost during the years of depression. Manganese, vanadium and nickel are common alloying agents for their so-called high-tensile steels, and one finds that different concerns concentrate on one or other combinations of these alloys. The use of titanium and other methods for controlling grain size is developing in America, but the author is not aware of

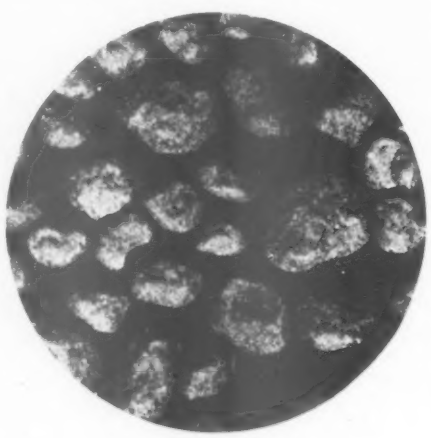

FIG. 15.—AMERICAN GREEN SAND AFTER RECLAMATION. × 25.

any British manufacturers exercising grain size control for steel employed in castings.

There is a certain school of thought in the British steel-foundry industry which believes that in order to defeat the rivals of steel castings previously mentioned, the existing standard specifications for steel castings should be stiffened. The author does not agree with this method of dealing with the problem, but suggests that it might be solved by introducing further specifications for high-tensile steel castings similar to that of the latest specification for railway castings issued by the Association of American Railroads, which originally had a Grade "A" for unannealed castings, and a Grade "B" for annealed castings giving 16 tons per sq. in. yield. It has now slightly improved the Grade "B" by specifying a yield of 17 tons per sq. in., and an ultimate tensile stress of 31 tons per sq. in., and has introduced a new grade "C" for high-tensile steel with a yield of 24.5 tons per sq. in. and ultimate tensile strength of 40 tons per sq. in., with a minimum elongation of 22 per cent. and reduction in area of 40 per cent. A purchaser of this Grade "C" high-tensile steel will naturally pay a higher price than for the ordinary grades of steel, which are sufficiently strong for general purposes.

(To be continued.)

The French Foundry Congress

The 17th annual congress of the French Foundry Technical Association, held at Lyon last month, under the presidency of Mr. H. Sandré, the Association's President, was the occasion for the presentation of an interesting series of Papers, mostly by French authors, though four were sent by the British, American, Belgian and German associations.

The British Exchange Paper, by Mr. T. R. Walker, M.Sc., of Sheffield, which has already been printed in our columns, dealt with the factors involved in testing sands. The American Exchange Paper, by Mr. J. Allan, gave a sketch of the American code for industrial hygiene, and dealt particularly with the precautions against dust to be taken during grinding and polishing of the castings. The question of de-dusting filters and ventilation of the shops was also dealt with.

Prof. E. Diepschlag, of Breslau, presented the German Exchange Paper, sketching the history of the use of cast iron, especially during the past century. Prof. Diepschlag recalled the specifications in use at various periods in the evolution of cast iron, and the effects of the improvement of the specifications on the consumption of cast iron.

Other interesting Papers were presented by Mr. J. Challansonnet, who reported the results of tests concerning the effects of the addition of vanadium and titanium to austenitic nickel-chrome and nickel-chrome-copper cast irons, particularly as regards the improvement of their modulus of elasticity.

Mr. G. Hénon spoke of the corrosive effect of the disintegration products of limestone flux on the refractory lining of cupolas. As a solution he suggested the use of coke impregnated with slaked lime, with which no flux need be used.

Mr. G. Godel presented a Paper on paints and varnishes suitable for patterns. Commercial shellac varnish was suitable if three coats were applied over a filler, while enamel varnishes, except blue and black, required only two coats over a filler. Cellulose varnishes, except black, were also suitable. Mr. Godel stressed the importance of proper varnishing and recalled the difficulties which arise when, through unsuitable varnish being used, the moisture of the moulding sand warps or swells the pattern.

Polish-German Trade Agreement

Under a Polish-German trade agreement, now under discussion, Polish exports to Austria will have to be shipped direct to the Reich to avoid using the Czecho-Slovak railways. Czecho-Slovakian railways, it is estimated, will lose about £500,000 a year through loss of Polish transit traffic.

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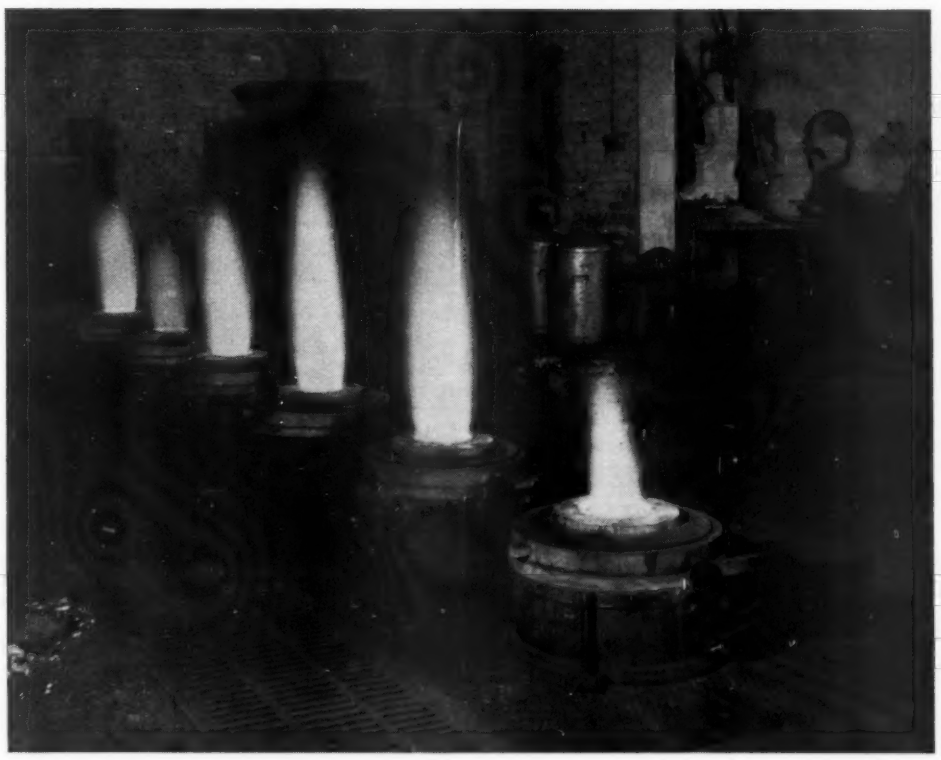

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The Week's News in Brief

Trade Talk

WALTER SPENCER & COMPANY, LIMITED, announce a change of London office address from 56 to 28, Victoria Street, S.W.1.

THE NEW "MAURETANIA" (33,000 tons) will be launched from the Birkenhead shipyard of Cammell Laird & Company, Limited, on July 28.

A WEEK'S HOLIDAY with pay is to be given to the entire staff at the Banbury and Birmingham works of the Northern Aluminium Company, Limited. Both works will be closed from July 29 to August 8.

A PARTY OF 65 from the works of Samuel Russell & Company, Limited, malleable and grey iron founders, of Walsall, spent an enjoyable day in London on Saturday last as the guests of the directors.

B.E.N. Patents, Limited, have appointed Robert H. Kulka, Limited, Shell-Mex House, Strand, W.C.2, their sole agents and distributors for the B.E.N. range of air compressors, spray-paint plant, etc., for the whole of Latin-America.

A CONVOY of 25 steel ingot casting bogies weighing over 250 tons and ten slag ladles left Thorncliffe, Sheffield, on July 5, by special train for Hull for shipment to Turkey. They will be incorporated in the new steel plant now being built at Karabuk for the Turkish Government.

THE PARTNERSHIP between Messrs. William Barker Marris, Harry Barton Marris and Frederick John Beverley, under the style of Marris Bros. & Beverley, at Kirton-in-Lindsey, Lincolnshire, engineers, machinists, iron and brass founders, has been dissolved by mutual consent.

THE BOARD OF EDUCATION SUMMER COURSE for teachers of engineering, normally held at Oxford, is being held this year at the works of the Metropolitan-Vickers Electrical Company, Limited, Trafford Park, Manchester. About 83 lecturers from 68 technical colleges are attending the course.

THE THIRTEENTH INTERNATIONAL ACETYLENE CONGRESS will be held in Munich from June 25 to July 1, 1939. The President of the Congress is Dr. Schmitz (Privy Councillor of Commerce, and chairman of I. G. Farbenindustrie A.-G., Frankfurt-a-Main). The address of the organising committee is Bennigsenstrasse, 25, Berlin-Friedenau.

THE THERMIC EQUIPMENT & ENGINEERING COMPANY, LIMITED, of Foundry Yard, Salmon Street, Preston, have taken over the British manufacturing and selling rights of a range of furnaces, designed by the Paris foundry-equipment firm of Penicud & Company. The range includes coke- and oil-fired rotating furnaces, as well as crucible melting plant.

SIR FELIX J. C. POLE, on behalf of the Metropolitan-Vickers Electrical Company, on Monday presented each of 105 employees who had completed 35 years' service on December 31, 1937, with a watch or clock. This token of appreciation was received by three directors and a number of managers of departments, as well as by staff and workpeople. The number includes four women employees.

THE LARGEST Stag Major Superweld butt-welded tools ever made have been supplied by Edgar Allen & Company, Limited, to the Brightside Foundry & Engineering Company, Limited, Sheffield, for parting the heads off iron castings weighing approximately 40 to 50 tons. These tools are 4½ in. deep in section by 1 in. wide and measure 5 ft. long overall. They have a square nose 1¼ in. wide and have been built up entirely by welding, no forging or smithing having been carried out at all.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Wallis-Noble, Limited, 63, St. Martin's Lane, London, W.C.2.—Capital, £1,000. Engineers, founders, etc.

Wardsend Steel Company, Limited.—Capital, £50,000. Director: W. W. Wood, 24, Taptonville Road, Sheffield.

Albert Taylor & Sons (Valves), Limited, Dowker Works, Milnsbridge, Huddersfield.—Capital, £8,000. Engineers, brassfounders and valve makers. Directors: A. Taylor, R. Taylor and H. Taylor.

Personal

LIEUT.-COMMANDER COLIN BUIST has been elected to the board of Horseley Bridge & Thomas Piggott, Limited.

MR. G. WIGHAM RICHARDSON, Mr. S. C. Swan and Mr. J. W. Elliott have been elected directors of Swan, Hunter & Wigham Richardson, Limited, Wallsend. Mr. Richardson and Mr. Swan are sons of present directors of the company. Mr. Elliott is secretary, and will retain that position.

MR. F. A. WEST and MR. C. E. KEARTON have been appointed directors of W. A. Walber & Company, Limited, who represent the Park Gate Iron & Steel Company, Limited, and the Widnes Foundry & Engineering Company, Limited, in London. Mr. A. C. Walber remains managing director.

MR. J. LÉONARD, for reasons of health, has decided not to continue as President of the Belgian Foundry Technical Association. The members have consequently elected Mr. Georges Moressée to that office. The new President received his technical training at Liège, graduating in 1904. In 1930, he was appointed general manager of the International Exhibition of Science and Heavy Industry held in Liège. He was the recipient in 1926 of a gold medal given by Liège University for his work in the field of physical studies. His business activities include chairmanship of the Compagnie des Compteurs et Manometres de Liège and the S.A. Recsi. He is also managing director of the Société des Produits Chimiques de Vaux sous Chèvremont, and the S.A. des Mines de Vedrin. He has received decorations from Belgium, Italy, France, Luxembourg and Greece.

Will

GOODWIN, OLIVER, founder of Goodwin & Company, metal merchants, of Birmingham £24,036

Obituary

MR. CHARLES GODFREY, railway wagon builder and repairer of Peterborough, died recently, aged 70.

THE DEATH has occurred of Mr. William Bates, aged 65 years, secretary and a director of Walker Bros. (Wigan), Limited, ironfounders, of Pagefield Ironworks, Wigan. He had been with the company for 45 years.

Contracts Open

Cairo, August 15.—Cast-iron pipes, valves, etc., for the Ministry of Public Works. The Department of Overseas Trade. (Reference T.Y. 23,673/38.)

Beckington, July 28.—Providing and laying 2,400 yds. of spun-iron water mains of 3-in. dia., for the Frome Rural District Council. Messrs. Parker Pearson & Ross Hooper, Dallas Chambers, Chippenham, Wilts. (Fee £1, returnable.)

London, E., July 23.—Provision and erection of hydraulic and other machinery and piping and electrical equipment, for the Walthamstow Town Council. Mr. T. S. Cunningham, borough engineer, Town Hall, Walthamstow, E.17. (Fee £2 2s., returnable.)

Company Reports

G. D. Peters & Company, Limited.—Interim dividend of 10 per cent.

Davey Paxman & Company (Colchester), Limited.—Dividend of 15 per cent.

George Kent, Limited.—Final dividend of 7 per cent., plus a bonus of 3½ per cent., making 13½ per cent. for the year.

Petters, Limited.—Net profit for the year to March 31, £19,580; brought in, £7,974; interest on funding certificates for the year to July 15, 1937, £1,032; dividend on the preference shares at the rate of 7½ per cent. per annum for the half-year ended March 31, 1937, £5,625; income tax, £2,300; dividend on the preference shares at the rate of 5½ per cent. per annum for the half-year ended September 30, 1937, £4,125; interest on funding certificates for year to July 15, 1938, £962; dividend on the preference shares at the rate of 5½ per cent. per annum for the half-year ended March 31, 1938, £3,987; carried forward, £3,369. Meeting, July 15.

Company Meetings

Edgar Allen & Company, Limited

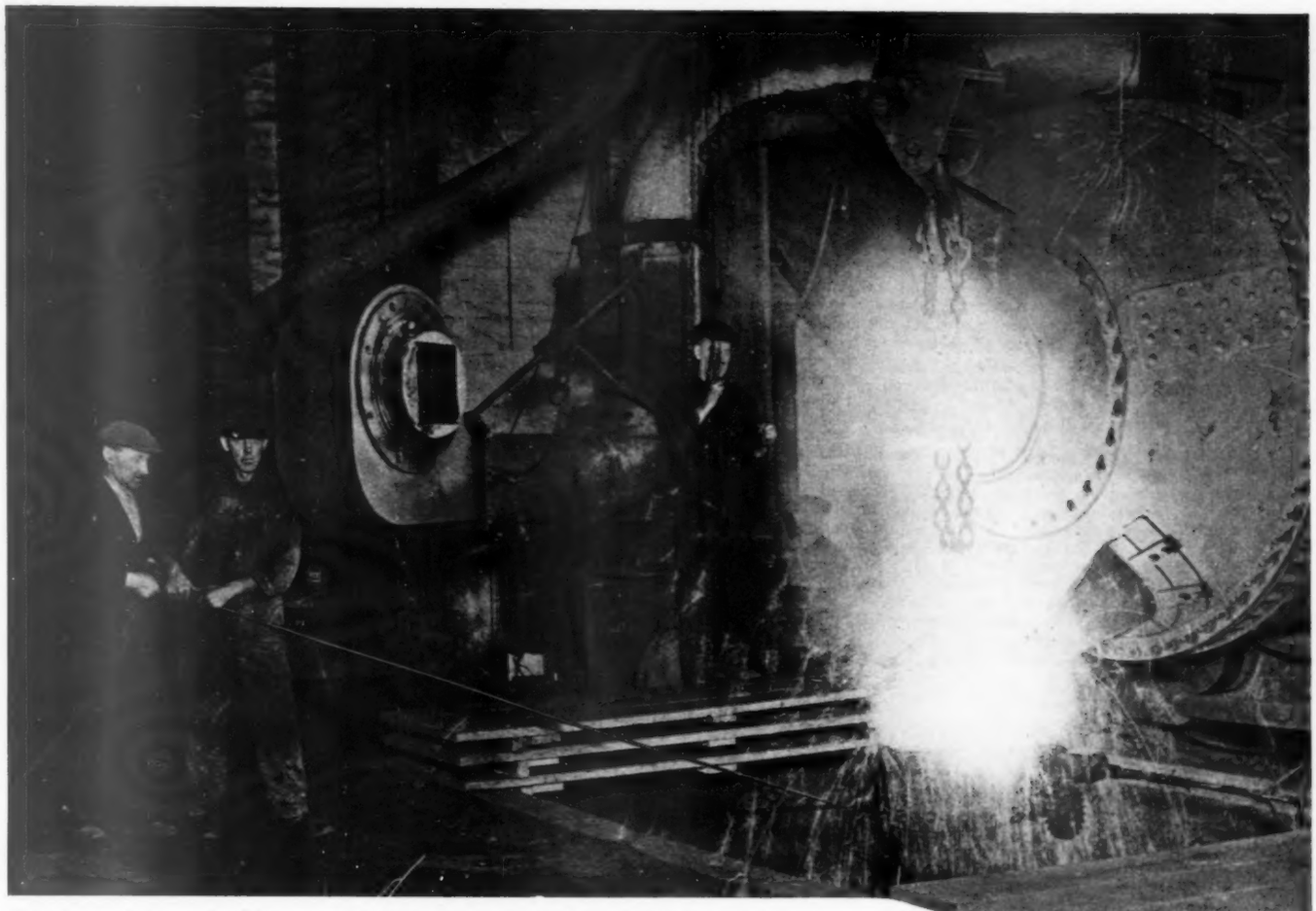
Presiding at the annual meeting of Edgar Allen & Company, Limited, held at Imperial Steelworks, Sheffield, MR. C. K. EVERITT (chairman) said that the company's financial year, ended on March 31 last, was one of unusual prosperity. Trading conditions, generally speaking, were satisfactory, demand was constant, selling prices on the whole were favourable, and turnover was substantially increased. The company carries on a very varied business. The manufacture of high-speed and general tool steels and of stainless steels; of machine-cutting tools for the engineering trades; of magnets and of saws; the production of steel castings on a large scale, of railway and tramway material, and of cement-making, crushing and grinding machinery and plant were all departments of its activities. This diversity of products had its advantages; it was in a large measure an insurance against sharp and possibly permanent declensions of trade. But, as he had pointed out at previous meetings, unless all departments were kept as fully occupied as possible, there was danger that enforced idleness or comparative inactivity in one section might eat up the profits earned in another. Fortunately, during the year just ended, activity had been general and was reflected in the accounts. Total turnover was more than 25 per cent. in advance of last year's figures.

Stewarts and Lloyds, Limited

An improvement in the company's order-book since the annual meeting in May was announced by MR. A. C. MACDIARMID, chairman of Stewarts and Lloyds, Limited, at a special meeting of the company on July 5. Mr. Macdiarmid said that the results for the current year continued to be satisfactory, although the output for the first five months was not so large as for the corresponding period of 1937. He added that, while it was early to prophesy, if business continued at its present level, they could anticipate satisfactory results for 1938. The meeting was held for the purpose of increasing the capital from £7,370,275 to £10,370,275, by the creation of 300,000 5 per cent. cumulative third preference shares of £1 (to be converted into stock of that class when issued and fully paid), and 2,700,000 shares of £1 of no specified class. The creation of these new shares was approved.

Liquid Layers in Cu-Fe Alloys

A Paper in the "Science Reports of the Tohoku Imperial University," by KEIZÔ IWASÉ, MASAZÔ OKAMOTO and TÔZÔ AMEMIYA, deals with the formation of two liquid layers in copper-iron alloys. The immiscibility found in Cu-Fe alloys in the liquid state was re-investigated by the determination of the liquidus of these alloys as well as of the equilibrium of the liquid alloys at 1,450 deg. and 1,540 deg., special attention being paid to the existence of a very small amount of carbon in the alloys. The results obtained are as follows:—(1) On the liquidus curve of the pure Cu-Fe system no particular point can be found, and, consequently no monotectic reaction is likely to occur. (2) The existence of 1 per cent. of Al, Ni, Pb, Sn or Zn in Cu-Fe alloys, consisting of 50 per cent. of Cu and 49 per cent. of Fe, does not cause the separation of the liquid into two layers. (3) In the C-Cu-Fe system two liquids co-exist in equilibrium at 1,450 deg. and 1,540 deg. Each heterogeneous zone lies very near the side corresponding to the binary system consisting of Cu and Fe, but it does not cut that side, having a definite clearance (about 0.20—0.03 per cent. in carbon content) between the zone and the side. (4) Therefore, it may be safely concluded that in the Cu-Fe alloys no separation of liquid into two phases take place, either when they are pure or have a carbon content of less thtn 0.02—0.03 per cent. in the range of temperatures up to 1,540 deg. and probably in a still higher range, while they separate into two liquid layers, when they contain more than the above percentage of carbon. The amount of carbon necessary to cause the separation varies as the content of iron in the alloy; the larger the amount of iron in this the more carbon it must contain. (5) The temperature coefficient of the mutual solubility of the conjugates is found to be positive, differing from the results found in the published reports. It has also been explained how the temperature coefficient may falsely be taken as negative by a proof of the fact that the higher the temperature at which the alloy is heated the greater the amount of carbon absorbed by it.



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MIDDLESBROUGH OFFICE: Halifax Bldgs., Exchange Place. Telephone: Middlesbrough 3313. Telegrams: "Genefax, Middlesbrough." (Mr. J. A. Williams).

BIRMINGHAM OFFICE: 5, Lower Temple Street Telephone: Midland 6376. Telegrams: "Genefax, Birmingham." (Mr. G. Griffiths).

Raw Material Markets

The outlook in the iron and steel markets over the next few months is not very encouraging. It is difficult to estimate how long it will be before there is a general return to normality as far as the placing of new business is concerned. At present, consumers in most instances are overstocked, while consumption among some consuming trades is well below the normal level. No doubt it will be well into the autumn before there is any perceptible buying movement, and the trade outlook will determine the strength of this. The proposed intensification of the Government's rearmament programme does not seem to have played so important a part as had been anticipated, although the heavy industries would probably be very badly situated if it were not for armament orders.

Pig-Iron

MIDDLESBROUGH.—The absence of export inquiries continues to be very pronounced, and pig-iron shipments are now at an extraordinarily low level. In fact, only 8,955 tons were shipped from the Tees during the past six months, as compared with 50,179 tons in the first half of 1937. Orders on home account remain almost negligible, and new business involves small parcels only. It must not be overlooked, of course, that there is no real incentive to buy ahead, as prices have been fixed up to the end of the year. For delivery to Middlesbrough and elsewhere on the North-East Coast, No. 3 Cleveland G.M.B. is quoted at 109s., with Falkirk deliveries at 109s. and Clydeside at 112s., all less 5s. rebate.

There is still little activity in the hematite market and only small parcels are being taken up. Export trade, also, is restricted to meagre tonnages; producers' stocks are very heavy, and there appears to be little likelihood of these being materially reduced in the near future. East Coast mixed numbers are quoted at 132s. 6d. on the North-East Coast, 138s. Sheffield, 140s. 6d. Manchester, and 143s. 6d. in the Midlands.

LANCASHIRE.—Consumers continue to call for reduced deliveries under contracts and the holidays are likely to preclude any real expansion in the demand. Another factor in the reduced consumption of foundry iron is the increasing use being made of scrap where possible. The demand for hematite is quiet. For delivery in Manchester and district, offers of Staffordshire and Derbyshire brands of No. 3 foundry iron are on the basis of 114s., with Northamptonshire at 112s. 6d. and Derbyshire forge at 111s. to 113s., according to the class of user. Scottish brands of No. 3 are on offer in the region of 137s. 6d.

MIDLANDS.—There is still no need for consumers to place further orders for pig-iron, their stocks being more than sufficient to meet their requirements. The fact that many producers have still substantial deliveries to make under existing contracts is due to the inability of the consumers to accommodate further tonnages. Makers of light castings are badly situated and improvement here seems to be a very slow process indeed. The demand for hematite is small. A free market exists for low-phosphorous iron and the price varies, according to quality and the source of supply, from £5 15s. to £7. There is an expanding call for this iron. Business in refined iron remains very dull.

SCOTLAND.—Only a small trade is being done in pig-iron and consumers are refraining from renewing old contracts. No. 1 foundry iron is quoted at 120s. 6d., with No. 3 at 2s. 6d. less, f.o.t. furnaces. With the foundries in the Falkirk area closed for the holidays the quietness is even more acute. Quotations for steel-making irons are:—Hematite mixed numbers, 133s.; Scottish basic, 107s. 6d.; English and Indian basic, 100s., all less 5s. rebate, f.o.t. steelworks here. As most of the steelworks are fully covered, deliveries of iron are only small.

Coke

Ironfounders continue to show little interest in new business apart from hand-to-mouth buying. Lower prices have so far failed to stimulate trade. Coke makers stipulate that the current quotations of 50s. 6d. for best Durham foundry coke and from 50s. 6d. to 60s. for Welsh, delivered to Birmingham and Black Country stations, will remain in force till the end of the year, but consumers consider that the figures are still too high.

Steel

Trading conditions in the steel market remain quiet and the holiday season has begun to influence the situation. Arrears of orders have been worked off, and in practically all departments it is possible for the makers to give near delivery. With the demand at its present level, little impression is being made upon stocks, and it is evident that a month or so must elapse before business is likely to revive. There is a considerable amount of idle plant in the semi-finished steel department of the industry. The stocks in consumers' hands are large and are slow in passing into consumption. As a result of this position the transactions now taking place relate principally to small parcels. The demand for finished steel is irregular, and has declined during the last few months, partly owing to holiday stoppages, but a considerable tonnage is still being taken by the consuming works. Export business, however, remains poor, and foreign buyers are not showing much interest in the market.

Scrap

Iron and steel scrap continues to be in poor demand. The present state of the market is due largely to the reduced production of steel. Steelworks are well supplied with scrap, as, also, are other consumers. Even when trade does improve, it will be a considerable time before the call for scrap returns to normal.

Metals

Copper.—Although the tone of the market remains firm, speculative interest continues to play an important part. It is appreciated that this is not usually the time of the year for a boom except that one is aided by artificial conditions. On the Continent, business has been fairly substantial, while the U.S.S.R. continues to be in the market for good tonnages. In the United States, sales have been at a high level during the past week. Both new-metal and scrap prices have risen.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £39 13s. 9d. to £39 16s. 3d.; Friday, £38 6s. 3d. to £38 7s. 6d.; Monday, £38 15s. to £38 16s. 3d.; Tuesday, £37 18s. 9d. to £38 1s. 3d.; Wednesday, £38 17s. 6d. to £39.

Three Months.—Thursday, £40 to £40 1s. 3d.; Friday, £38 12s. 6d. to £38 13s. 9d.; Monday, £39 to £39 1s. 3d.; Tuesday, £38 5s. to £38 6s. 3d.; Wednesday, £39 3s. 9d. to £39 5s.

Tin.—Little interest has been displayed by consumers recently, but the market, helped by the speculators, has a firm tone. American trade is quiet.

The terms of the agreement for the tin buffer stock scheme have been announced by the Colonial Office. The initial buffer stock will consist of approximately 10,000 tons of tin. This may be increased to a maximum of approximately 15,000 tons by resolution of the International Tin Committee. To operate the buffer stock on behalf of the signatories, an executive body will be appointed, with offices in London. No person "who is at present concerned as a principal or employee or agent or representative of any tin mining or smelting company or of any business engaged in the marketing or distribution of tin shall be eligible for appointment as manager or assistant manager." A sub-committee consisting of the chairman and vice-chairman of the International Tin Committee and a representative nominated by the Bolivian delegation will appoint the executive.

The present objective of the scheme is to maintain a price ranging between £200 and £230 sterling. This price range may be varied by a resolution of the I.T.C. Unless renewed by a further agreement, the buffer stock scheme will be terminated on the same date as that on which the present International Tin Agreement may terminate, but subject to the following conditions:—(*a*) Any cash balance shall be distributed *pro rata* to the signatories not later than three months after such termination. (*b*) Any tin then remaining in the buffer stock shall be liquidated within two months at a price of not less than £200 a ton, or, if market prices do not permit of £200 being obtained, then at a rate not greater than one-twelfth of the remaining stock a month, and the proceeds distributed to the signatories *pro rata* to their contributions.

Official quotations were as follow :—

Cash.—Thursday, £193 15s. to £194 5s.; Friday, £189 to £189 5s.; Monday, £189 12s. 6d. to £189 17s. 6d.; Tuesday, £189 to £189 5s.; Wednesday, £192 10s. to £192 12s. 6d.

Three Months.—Thursday, £195 to £195 5s.; Friday, £190 5s. to £190 10s.; Monday, £190 15s. to £191; Tuesday, £190 to £190 5s.; Wednesday, £193 15s. to £194.

Spelter.—The present buoyant tone of the metal market generally is reflected in spelter, although new buying is still very restricted. Of the chief consumers only brassmakers are taking up anything like normal tonnages.

Daily market prices :—

Ordinary.—Thursday, £14 7s. 6d.; Friday, £13 15s.; Monday, £14; Tuesday, £13 12s. 6d.; Wednesday, £14 5s.

Lead.—The turnover in this market has been heavier of late. As a result of the firmness of the American stock markets, speculators have been encouraged to take up supplies, as they are of the opinion that prices here are likely to advance still further. Should there be anything of a decline on Wall Street no doubt that would be reflected in this country. At present, however, that does not seem likely and the lead quotation in the United States has been advanced still further.

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £15 8s. 9d.; Friday, £14 16s. 3d.; Monday, £14 16s. 3d.; Tuesday, £14 10s.; Wednesday, £14 18s. 9d.

Scrap.—There has been a very welcome revival of buying and the tone of the market is much stronger. It is generally felt that the improvement will be more than temporary. During the past week quite large tonnages have changed hands.

Approximate selling prices for old metal:—New aluminium cuttings, £72; rolled, £56; cast, £28; foil, £88. Copper, £36 to £39; braziery, £31 to £32. Brass (clean), £22 to £25. Zinc, £9. Lead, £14 10s. Gunmetal, £39 to £40.

Catalogues Received

Shot-Slinging Cleaning Machines. The Constructional Engineering Company, Limited, of Titan Works, Charles Henry Street, Birmingham, 12, have sent us a folder and a leaflet dealing with the performance of the "Sand Wizard." The former contrasts the fundamental differences in the operation of the "Sand Wizard" and the ordinary shot-blast machines, gives some details as to cost reduction, includes a number of statements from satisfied users, and carries a number of illustrations of the various types of plants available. The leaflet deals with the results obtained by a firm of malleable ironfounders whose cleaning costs spread over a period of 27 weeks, dealing with 130 tons of castings per week, averaged just over 2s. 4d. per ton. This firm has now five "Sand Wizards" of varying types.

Summer Ventilation. An eight-page folder has been issued by Keith Blackman, Limited, of 27, Farringdon Avenue, London, E.C.4, which, by well-written text and adequate illustration, emphasises that a well-ventilated factory has an ameliorative effect on both quality and quantity of output. A second folder, carrying the title "Urgent Problems arising out of the New Factories Act, 1937, and Some Practical Suggestions for their Satisfactory Solution," was received by the same post. This is a broadsheet, and covers the questions of heating, ventilating, dust exhaust and fume removal. These pamphlets give one confidence that, by a certain amount of capital expenditure, compliance with the Factories Act may be turned to profit.